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Getting the Most Out of Your Machine Tool Dollar

By Wm. Bailey
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KEEPING up-to-date in management and equipment is fundamental with any business. Poor management can wreck a business in spite of good equipment and the best of management many times is unequal to the task of offsetting the deficiencies of obsolete equipment. No individual should be expected to carry unassisted the full burden of both management and equipment, or of either.

Recognizing these truisms, the Hoover Company has delegated to its foreman the duty of assisting their manager of production in discovering the equipment and methods best suited to the company's needs. At certain periods the foremen are engaged in a suggestion contest regarding improvements in production methods. The prizes are provided by the foremen themselves, in this way: Each foreman hands in his suggestions and along with them fifty cents as a contribution to a pool that is given to the foreman with the best suggestion. This method has the advantage of putting the foreman on his mettle not to lose something he already has, as well as to win something to add to his salary.

To keep the foreman posted on equipment and methods the company subscribes to all of the magazines applying to his job. The copies are so routed that each foreman gets one magazine at a time. There is a time limit beyond which he may not retain it, but he is permitted to do his reading during working hours. The magazines are returned to the production manager, who marks articles pertinent to the departments of certain foremen, calls those foremen to his office, and in private conferences finds out what they learned from their reading. The periodic reporting of new equipment by the magazines is a constant and valuable source of information. The descriptions of machines are studied and from them new equipment applicable to our work is discussed. A recapitulation, or summary of new equipment brought out over a longer period of time, such as the *American Machinist* semi-annual shop equipment review, is of value in that it provides the foreman, who has an idea for a new method, a source from which to locate the equipment that will enable the execution of the new method.

> When a machine is worn out it goes to the junk dealer. Most of our equipment goes out that way, because, due to our policy of sticking to the standard machine, there is little obsolescence brought about by change in design of machine tools. We do have obsolete machinery.... .....and such machinery is sold as second-hand if we can find a market within six months. If we do not find the market the machinery is junked, because our floor space is too valuable to give up to it

Any proposed new method is explained to all of the foremen and they are asked if they have in their departments machinery that is applicable. After full discussion by the foremen the tool engineer is instructed to select from the information and data provided the equipment best suited for the job.

In selecting a machine we consider:

1. The possibility of the investment's paying for itself within from two to three years.
2. Whether or not the proposed machine is easily convertible to do other operations. Is it special or standard, as those expressions are usually understood?
3. To what extent the proposed machine will effect our "in process."
4. The effect upon floor space.
5. The effect upon power consumption. Will it upset our power factor?

To enable us to prove up the investment we have set up machine-hour rates on all of our machines. For the proposed machine we estimate a machine-hour rate, which we are able to determine very accurately, and compare the two. We also apply a formula, very similar to that given by Mr. Runge* in an earlier article in this series, to determine the time during which the investment will be returned by savings. The two results are compared and a check is thus secured on the problem.

Overhead from Burden Control Record

Perhaps our method of calculating changes in overhead differs from Mr. Runge's. Whereas he has determined that "if the expense of productive labor is cut in half the percentage of overhead to productive labor is increased ten per cent," and uses that ratio in his formula, we determine the change in overhead from a "Burden Control Record."

The burden control record is a series of graphs showing direct labor, direct and indirect burden, and fixed burden. They are made by plotting the actual expenditures for direct labor and burden. From this graph the trend in relationship between the above factors is easily determined. From the graphs the amounts can be estimated. While the costs of indirect and direct burdens are decreased with the decrease in the cost of direct labor, the decline in burden costs is not as rapid as the decline in direct-labor costs, and the result may be that the burden per hour is higher on a new machine than on the one to be replaced, while at the same time the production cost per piece is lower.

Direct labor charges are of course, not sub-divisible. They are directly controllable by the foremen.

Direct burden charges, which are plant variable charges over which the foreman has a large amount of control, are made up of charges for:

- Indirect labor
- Melting labor
- Defective material (due to spoilage in process)
- General stores and factory supplies
- Shipping materials
- Stationery and office supplies
- Fuel
- Gas
- Power purchased
- Bag treating
- Indirect material on product
- Nickel-plating labor
- Repairs to machinery and equipment
- Interdepartmental expense

Indirect burden charges, controllable indirectly by the foremen, consist of charges for:

- Supervision
- Clerical salaries
- Insurance—workmen's compensation
- Repairs to buildings
- Power prorated
- General plant expense prorated
- Engineering expense
- Industrial relations

The fixed charges are for:

- Insurance—fire
- Insurance—miscellaneous
- Telephone
- Taxes
- Depreciation—buildings
- Depreciation—machinery and equipment

We conduct our production from an engineering viewpoint. A great deal of attention is given to studying set-up times, factors affecting quantities in process, and floor delays. We must strike a balance between the costs of article and set-ups and the interest losses on investments in materials in process and stores. At times our production provides for loafing on the part of operators. We do not look at it as a crime if a man isn't busy every moment of the day. Perhaps that statement sounds a bit radical, but to understand it, just consider the cost of a change of set-up or the interest on materials in process that might be required to keep every operator busy every working moment. It is not a policy to provide loafing time for employees, but there exists a recognition of the fact that the fundamental requirement of production work is the *control* of production.

An Example of Equipment Selection

Without going into details, and without attempting to cover all of the engineering phases of selecting equipment, I want to cite an example of the selection of certain equipment from an engineering viewpoint. We needed some polishing lathes and our minds were set upon installing a group of lathes with individual motor drives. In our check-up, we made a graphic watt-hour test on equipment that we had, comparable to the equipment that we intended to purchase, with buffing wheels mounted and buffing loads applied. It was found that the maximum load on each machine would be around 25 hp., but that the required load would be 6 or 8 hp., and that the induction motor losses on individual drives would cause a power-factor loss of about $800 or $900 per year.

The result was that we began to hunt for a belt-driven machine that would permit of a group-drive arrangement with the line shaft on the floor. The machine was found, that arrangement followed out, and we now have a group of four lathes driven from one 20-hp. motor instead of four lathes each with a 15-hp. motor. The saving on the cost of equipment alone was $3,900. Beside that, the machines are of the type known as standard, and can be changed easily to do other work if the polishing operations should be disbanded.

Auxiliary Equipment Must Be Right

Getting the most out of your machine tool dollar means more than selecting the right machine at the right time. It means having the right auxiliary equipment and the right production control. For instance, there is our conveyor equipment. Perhaps we got just as much production per machine per hour before the installation of the conveyor equipment as we do now. But we were not getting the return per dollar of machine tool investment that we get now. By means of the conveyors the material "in process" has been cut 76 per cent. The stores department is manned by 8 men instead of 32, and is centralized for both raw material and finished product. The inspection department is centralized and is run on a schedule. In fact our entire work, from issuing parts from stores through machining, parts inspection, plating, parts storage, assembly, final inspection, and shipping, is run on the equivalent of a railroad schedule. An understanding of what our conveyor system has meant may be had from a study of the routing of the large main aluminum casting of the sweeper.

In the past it required thirteen days, from the time the raw material was made into castings in our die shop to get the material through as a finished article. This same casting is now cast in the foundry, carried through all the stages of manufacture and on to the finished sweeper within the period of ten hours.

The approximate annual earnings from the conveyors

*Getting the Most Out of Your Machine Tool Dollar, by Robert F. Runge, vice-president, SKF Industries, Inc., *American Machinist*, Vol. 62, page 719.

that we have installed are well up in the five figures.

As has been said, our foremen keep in touch with developments in shop equipment. There is one contact that they do not have, as a rule; that is the contact with machine tool salesmen. We have found it necessary to deal with all salesmen through the purchasing department, which sifts from the many callers those who are to go further, and they see the production manager, not the foremen. That arrangement is adhered to in the interest of conserving the time of the foremen and the production manager. There have been several influences having to do with its adoption. Among them is the fact that the percentage of salesmen trying to sell on an engineering basis is too low.

Economics of Selling

I cannot afford time for the salesman whose inflexible attitude is that his machine can out-produce those of his competitors under any and all conditions. In selling machine tools probity, faith and good-will enter into the relations between seller and user just as they do in transactions involving other commodities, such as materials and supplies. If a salesman insists upon making arbitrary statements that I know he cannot back up, he is building ill-will instead of good-will. I cannot help but contrast him, and the policy of his company, which presumably he is presenting, with another salesman and another policy by whom and in accordance with which I am given to believe that their interest is to see that I get what is best for my purpose. There certainly is sound reasoning back of a policy that directs the salesmen of a company to work primarily for the user of machine equipment by lending their services and their knowledge to see that he gets the equipment most suitable for his work whether it is of their own make or not. It is a policy economically sound and means in its last analysis the survival of the fittest, which is the ultimate result anyway.

It is not good business, it is not good economics, for effort to be spent upon accomplishing the installation of equipment that is not the most efficient for the job. Where machines compete, it is quite understandable that each may find a sufficient market where it alone excels. When a manufacturer finds that he is trying to sell in the wrong market he should retire gracefully. If his market constantly shrinks, he is likely to be out of step with the economic scheme of things and the probabilities are that he is a follower, not a leader, in design. The remedy for his troubles is obvious.

Another source of information for our foremen is the machinery exposition. We have representatives at the "shows" of the American Society for Steel Treating and the American Foundrymen's Association and at the electrical show in New York City. Still another source of information is the factory visit. Our higher foremen are sent out at least once a year to visit other plants, but not the plants of our competitors.

It is my feeling that there is an element of risk in visiting a competitor's plant, a risk of inducing the wrong frame of mind on the part of the visitor. We want our men to think for themselves. It seems logical to believe that by visiting plants making our own type of product they will be inclined to copy rather than design. Having done a thing one way, or seen it done one way, there is a tendency on the part of the individual to do it that way. To visit plants where comparable work is done, where work similar in size, or material, or some other respect, is done, will give ideas. To visit plants where the same kind of work is done may not.

When an idea of magnitude, no matter from what source received, has germinated, developed, and been brought to the experimental stage, it is not introduced at once into the production department. It is put into the toolroom, and a man is taken from the production department and put there to live with it during its experimental life. The production man works along with the tool engineer until the young idea is graduated to production and then he goes to the production department with it as its sponsor until it has made its way.

The average life of our machine tools is fifteen years. They wear out as a result of being run at high speed rather than because of the loads they carry. Much of our material is aluminum, the parts are small and the amounts of metal removed are slight. Because of the nature of our product, also, the manual labor is not heavy. In spite of that we never let a man do what a machine can do. We always try to get machines as fully automatic as we can, arranging for the operator to take care of more than one machine or to perform more than one operation.

Special machinery enters into our processes, but machinery that probably is not special within the meaning of the term as ordinarily understood. Perhaps as concise a definition as I can give of our special machinery is that it consists of standard machines to which we have applied special equipment designed and made in our own plant. We have a strong dislike for the machine so special that the abandonment of, or a change in, the operation for which it was designed, leaves the machine stranded. We dislike such things as fixed centers, because they are too likely to be a retarding influence as regards improvement in design of product. What we aim to have is convertible equipment and our experience has shown that standard machine tools are more readily convertible than any others.

Much Equipment Is Junked

When a machine is worn out it goes to the junk dealer. Most of our equipment goes out that way, because, due to our policy of sticking to the standard machine, there is little obsolescence brought about by change in design of machine tools. We do have obsolete machinery because of change of methods of manufacture, or change in design of our product, and such machinery is sold as second hand if we can find a market within six months. If we do not find the market the machinery is junked, because our floor space is too valuable to give up to it. We are not careless of our own welfare in disposing of machinery. Each foreman knows of every machine in the plant that is to go out, and until it has actually gone he has the privilege of finding a place for it so long as his use of it will match up to our equipment policies. Announcement is made at the foremen's meetings of equipment slated for discard.

Although we use standard machines almost exclusively we are not entirely satisfied with them.

Bearings are not always to our liking. Other things being equal, we buy machines with ball or roller bearings, preferably the latter, when we can get them.

Present-day multiple-operation machines require too long a time for indexing. On many of our operations we use single-spindle machines on that account. It

does not pay us to make the greater investment for multiple-spindle machines.

On some machines slides are not long enough. There is not the wearing surface that could be provided.

On some of our milling machines the knee is apparently too light. The base and column are heavy and rigid, but the sturdiness has not gone far enough.

Punch presses could be of heavier design.

On some machines collets are too light to hold cutting tools heavy enough to do all of the cutting that could be done.

On many machines a shear pin should be provided to prevent wrecking the entire machine in case of accident or error. On others, particularly special machines, where shear pins are provided, they should be closer to the work.

With lubrication we have no quarrel. Past experience led us to adopt the Alemite system on practically all machines where it is suitable and to install automatic lubricating devices where deemed necessary. As a rule we apply one or the other method to new machines as they are put into use.

What seems to me to be most evident, and what apparently it is difficult to learn, or teach, as may be, is that these matters of equipment buying, using, designing, selling, and finally junking, should be handled from an engineering point of view. There are available a great array of facts, as to what machines have to do and what they will do. When these facts are collected, classified, and re-expressed, in dollars, there is the answer to the equipment problem.

[The preceding article is the tenth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. Other articles on the same subject will be published in forthcoming issues.]

Drafting Responsibility

By John F. Hardecker

"Say Jack," inquired Bill Smith of his fellow chief draftsman, "do you have any men in your organization who up to a certain point are good draftsmen—and stay just that—never seem to be able to get over the hurdle of real responsibility?"

"Yes," said Jack, "you assign them a job and after they investigate it in a commendable way, they come back with the story, and you have to put them on their mark and show them which lane they're to run in. I expect we all have them, and the only way out that I can see is to take them into your confidence and explain the situation to them. I try to convince them that as draftsmen they'll always be fairly certain of their jobs, but that if they want to get ahead, they'll have to do more than just dig out the facts; that they should never come to me unless they have at least one possible solution of the problem. You'd be surprised how well just putting the question of responsibility right up to them really does work out."

Seen and Heard

By John R. Godfrey

Let's speak the same language about fits

THERE'S a lot of misunderstanding seen and heard about gages and gaging. And a lot of meaningless chatter about limits and tolerance.

Frequently it's a lack of appreciation of the real meaning of the words, but it's quite often a bluff to impress the listeners with the idea that the speaker has both skill and knowledge that he doesn't possess. "Working to a thousandth" may mean one or two thousandths, depending on whether tolerances are unilateral or bi-lateral. In the bi-lateral system, a thousandth plus or minus, means a total of two thousandths as the tolerance. It isn't the "limit" in either case, however, even though it is frequently so called by many who ought to know better.

All who make parts of any kind in quantity, ought to learn the language of interchangeable manufacture. They should know that *limits* are the total minimum and maximum diameters that are permissible for the acceptance of a piece. The difference between upper and lower limits is the total tolerance, regardless of whether the unilateral or the bi-lateral system is used. And only the total tolerance should be mentioned when accuracy is being debated.

There's another factor in making fits that frequently gets mixed up with limit and tolerance; that is "allowance." Allowance is sometimes called a neutral zone, a sort of "no-man's-land," that should be space unoccupied between the hole and the shaft.

Allowance has nothing to do with tolerance except that it may be affected by it unless selective assembly is used. Allowance is the space between the shaft and its bearing for the oil film and is usually a fixed amount, entirely independent of the tolerance on the shaft or bearing, if best results are considered. Where selective assembly is not used, allowance is the minimum looseness of fit between the shaft and its bearing, and is not a measurement for the mechanic to worry about. If the shaft and hole are within the specified tolerance, the designer and the assembler are the ones to worry about the allowance.

It is high time that all who make things mechanical, used similar terms to designate the same thing. So long as we keep on mixing up limit, tolerance and allowance, we shall have misunderstandings and costly mistakes, not to mention hard feelings over not getting the kind of fit wanted.

There are a lot of advantages in using unilateral or one-way tolerances, where "tolerance" automatically gives the total permissible variation from the preferred size. But if anyone insists on using bi-lateral tolerance, and there are cases where some think it advisable, time, trouble and confusion can be saved by giving the *total* tolerance, instead of the plus or minus, and so prevent confusion.

It's bad enough to confuse the names of machines and machine parts, but there's more real grief over misunderstanding about the kind of fits wanted, or needed, on a job to make it satisfactory. Let's all learn to talk the same language when it comes to fits. Let's have limit, tolerance and allowance mean the same thing in San Francisco that they do in Boston.

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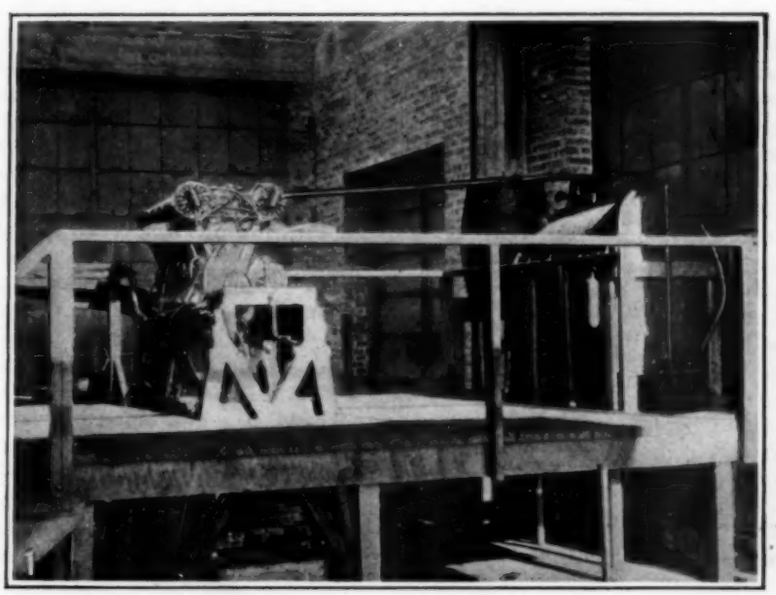
Maintenance, Repair and Servicing Equipment in Air Transport

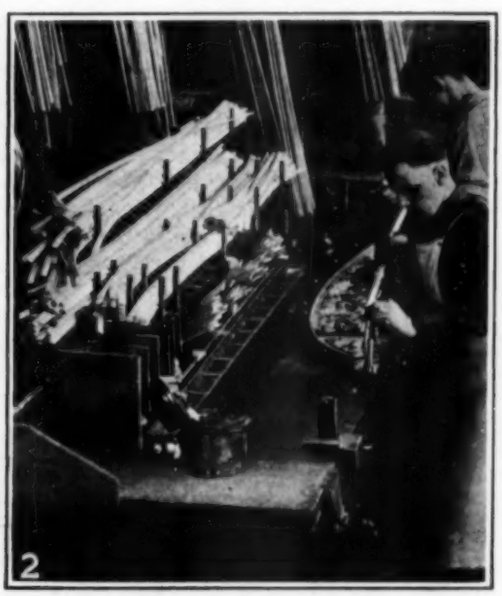
By Archibald Black
Consulting Air Transport Engineer, Garden City, N. Y.

IT IS not the purpose of this article to cover in complete detail every single item of equipment required in the maintenance of airplanes, engines, landing fields and lighting equipment but rather to give a bird's-eye view of the whole picture. In general, maintenance, repair and similar equipment required in the operation of air transport routes may be divided into:

1—Airplane rebuilding and repair equipment.
2—Engine overhaul and repair equipment.
3—Airplane servicing equipment.
4—Operating equipment.
5—Field maintenance and miscellaneous equipment.

The type of equipment required for airplane repair work will, of course, vary according to the type of construction of the airplanes that are to be maintained. For general purposes, it is sufficient to regard the planes as being divided into two types of construction only; metal and wood. The various other types of construction are combinations of the two general classes of material in one form or another. The type of airplane which is in most general use today, is a composite structure of wood and wire with fabric covered wings. Frequently, and particularly so far as the fuselage is concerned, this construction is modified by the partial or complete elimination of the fabric and wire. These materials are replaced by a structure of wood members covered with thin sheets of plywood, to provide both diagonal strength and covering. The well-known De Haviland airplanes use this type of construction very largely. Other types make use of the conventional fabric covering, but are provided with a metallic structure of welded steel tube, formed duralumin or steel, or a combination of all three. Still other types of airplanes are constructed wholly of metal, even to the covering material, which is of thin sheet duralumin, ribbed or cor-





1—Engine test-stand, Air Mail Shops, Maywood, Ill. 2—Building up wing ribs

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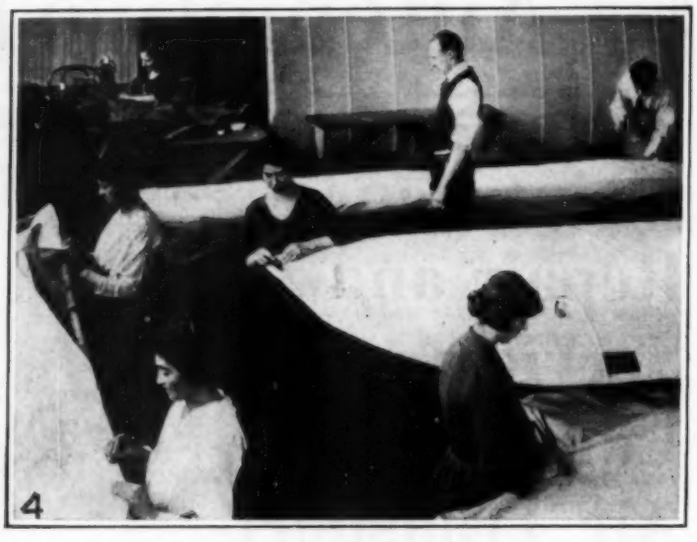

3—Jig for building bulkhead. 4—Covering wings and rudders

rugated to provide rigidity. It will therefore be clear that the exact list of equipment required for repair work, will depend very greatly upon the type of construction of the airplanes.

In repairing the wooden parts of airplanes, the general run of cabinetmaking shop equipment will be required, including such items as carpenter's benches, jig saw, spindle shaper, jointer, planer, steam box, glue pot and small tools. For repairs on the metal parts, the equipment required will follow that usually found necessary to handle the general run of tin-shop work, with possibly the addition of some brazing and acetylene welding equipment. The items usually required will include such items as sheet-metal workers small tools, soldering-iron heaters, beading machines, tinsmiths' brake, pipe bender, and, for special fittings work, a Gray sheet-metal profile cutter. If wires are used in the airplanes to be repaired, as is usually the case, some special small equipment such as cable-terminal wrappers, wire-loop benders and wire- and cable-proof loader will be necessary. A blacksmiths' forge and anvil may sometimes be required, while small, sensitive, vertical drills and electric hand drills will be needed, without regard to the type of construction. If propeller work is to be included, such special equipment as a propeller checking table and balancing stand must be added to the list. In all cases where land airplanes are to be repaired, a wire-wheel truing stand should be provided. Frequently a force press, of the type used in garages, will prove very useful in the work of repairing worn wheel bushings and so forth.

In all cases, jigs adapted for use in the repair of wings, fuselages and control surfaces, will be necessary: Similarly, equipment for the truing up of the assembled airplane will always be required, and in this work, such items as a wing-assembly jig and some builders' levels, or other equipment for lining up the wings and body, are needed. In compiling a list of equipment for a shop, where the volume of work is small, it may prove better business to eliminate some of the items listed, and to figure on either using makeshifts or on sending certain jobs out to shops that are better fitted to handle them. If the airplanes to be maintained have fabric-covered wings or other parts, equipment must be provided for sewing the cloth. The sewing machines for this work are of the conventional type used in clothing factories. After the wings have been covered with cloth, several coats of "wing dope" are applied to the fabric, to cause it to shrink and become taut. The fumes of this dope, which is a cellulose compound, are very unhealthy to inhale, and it is essential that the room in which this work is to be done be well ventilated. If much work of the kind is to be handled, it is very desirable to provide a special room that is ventilated by forced draft. As the "dope" vapors are heavier than air, the general current of the ventilation should be downward. If, instead of fabric or plywood, the wings and body are surfaced with corrugated sheet metal, suitable equipment must be provided for heading the small rivets with which this material is generally fastened.

The equipment required for airplane-engine maintenance, differs but little from that required in the maintenance of marine- or automobile-engines. Indeed, a garage that is fully equipped for the overhaul of automobile engines, would require only the addition of a few special reamers, wrenches and, perhaps, a larger engine-overhaul stand to handle airplane-engine work. The items of equipment usually required include such items as a large-size engine-overhaul stand, chain block or similar handling device, small arbor press, gear pulling clamps, piston- and rod-alignment jigs, main-bearing line reamer, piston- and rod-balancing scale, piston vise, small screw cutting lathe, and the usual engine-shop small tools. Frequently, it becomes advisable to add a special rig for checking ignition equipment, and, in cases where any reasonable volume of work is to be handled a kerosene-spray system will be found a valuable aid in cleaning engine parts. In all cases, some type of engine-test stand should be provided. It is entirely unnecessary that this stand be provided with any means for measuring the horsepower, since its purpose is merely to give the engine a short test run. The construction need consist of substantial, wood engine-bearers only, with some conveniently-arranged gasoline, oil and cooling-water

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supply. If the stand is to be located indoors, a hood should be provided to carry away the exhaust gases. On account of the large horsepower of aircraft engines, it is entirely impracticable to permit the exhaust gases to escape directly into a room, no matter how well ventilated it may be.

The term servicing equipment, covers every item that is required to keep the airplanes ready for use. It includes such items as gasoline- and oil-storage systems, portable gasoline and oil tanks, water-supply system, tire pumps, battery chargers (required only where storage batteries are used on the airplanes or at the field), towing and mooring ropes, and tarpaulin covers. All of the gasoline and oil storing and handling equipment can be of the ordinary commercial type, no modifications being necessary. A few additional items of equipment, varying according to the particular station, will also be required, and many of them may be commercial products. For servicing of airplanes of the land type, wheel chocks (for blocking wheels), a handling truck or "dolly" (for keeping the tail skid off the ground when moving machines around) and, possibly, a portable engine-starter may be added. These items are not required in the handling of water types of airplanes, in which case the following items may be substituted: seaplane handling truck, mooring buoys (as used for motor boats), small anchors, some hauling-out equipment (such as a crab, capstain or small gasoline tractor) and beaching tracks or runways. If the use of a seaplane station warrants, a small power boat should be added to the equipment, otherwise a rowboat may be substituted.

Apart from what might be termed the "flying equipment," air-transport stations require operating equipment that includes such items as wind-cone or other suitable wind-indicating device; signal flares or lights, landing floodlights, obstacle-marking lights, route-marking beacon, miscellaneous meteorological and other small equipment of standard design. Fire fighting equipment, in the form of hand fire extinguishers, should be liberally provided, even at the least used operating base. If the station is to be used by land types of airplanes, it may be advisable to include in the equipment, a small tractor with a grass-cutting attachment. The tractor is an item of equipment that is very generally useful in any case, since it may be used also for hauling seaplanes out of the water; for clearing snow, and for road maintenance work around the station. If the latter two classes of work are to be included, suitable snow-plow and road-drag attachments must be added.

Abstracts

from other publications

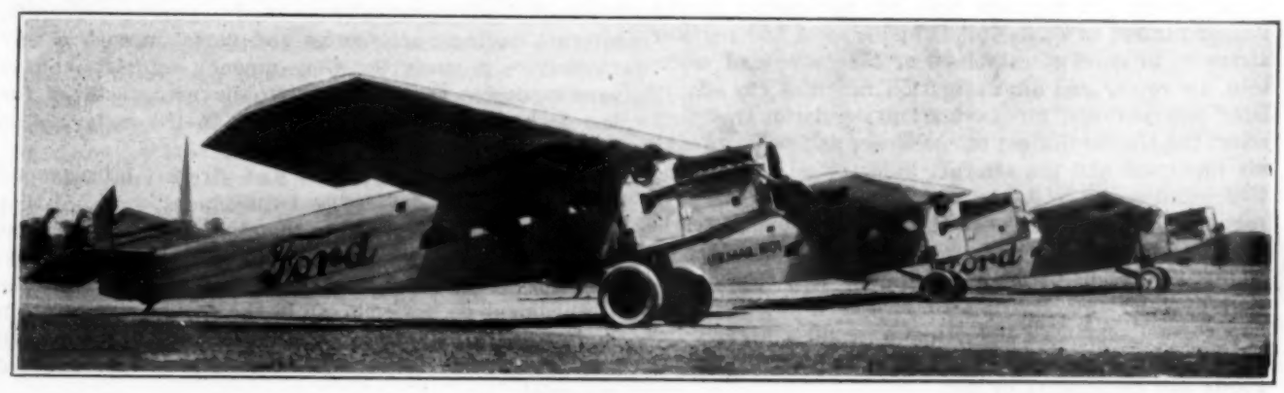
Customers' Machine Shop

Comparatively few garagemen are able to equip their shops with all the machines they need in order to take care of every operation with a minimum expenditure of time and labor, and it is to be expected that they would feel grateful to anyone who would offer them the use of a fully equipped machine shop at a cost somewhere within reason.

The Puritan Autoparts Co. has installed what it terms a co-operative machine shop for the convenience of customers and is operated on a cost basis. This shop is equipped with an arbor press, two drill presses, two lathes, a piston grinder, an alignment jig, welding equipment, a special flywheel, ring-gear heater, reamers, taps, dies, precision instruments and a first-class machinist is employed to devote his entire time to the shop, acting chiefly in an advisory and supervisory capacity. Customers do their own work as a rule and are free to do it in their own way. This service is meeting with a ready response.—*Motor World Wholesale*, Nov. 5, p. 30.

All-Steel Bodies

K. W. Stillman states that the prevailing opinion about all-steel bodies has been that although they might be satisfactory from a design and operating standpoint, production and cost considerations limited their use considerably. The Jordan Co. has announced, however, that the Edward G. Budd Manufacturing Co. is now making all-steel bodies for them. Die costs are not so great as is generally believed because of recent developments in die machining methods. The number of pieces necessary for this type of body is considerably less than for most other types and this makes assembling more simple and the use of electric spot welding reduces the period of the production cycle from presses to shipping room to about 45 minutes, more economical production and installation of upholstery is made possible and finishing processes are considerably accelerated. In the Jordan sedan there are just 24 pieces which make up the frame and body.—*Automotive Industries*, Nov. 5, p. 778.



AUTOMOTIVE PRODUCTION

To Secure Progress in Civil Aviation

RECOGNIZING the national deficiency in this field, the Department of Commerce and the American Engineering Council for some time past, have gathered information relative to civil aviation. In June 1925, a joint committee was formed to make a reliable comprehensive survey of the commercial and economic aspects of aviation thoroughout the world, and to recommend the measures necessary to encourage a national development of commercial aviation in the United States.

This committee has canvassed all reliable sources of information on commercial aviation in the United States and abroad. It has ascertained the experience and attitude of American business interests and operators relating to commercial air activities, and the results of operations in the the important countries of the world.

Three Purposes Involved

The promotion of civil aviation in the United States is predicated, in the committee's opinion, upon three underlying principles:

First, the development of commercial uses of aircraft is of great importance industrially and to the national defense. Second, air navigation should and can be developed primarily as a constructive agent for the public welfare. Third, the provision of essential air-navigation facilities is a public responsibility. If these facilities are provided, a direct subsidy to civil aviation enterprises is unwise and unnecessary.

The committee finds that certain fundamental difficulties are retarding the development of civil aviation in the United States, which may broadly be summarized as:

The lack of a definite legal status and government control.

The lack of an established government program to encourage the civil and industrial uses of aircraft.

The lack of commercial aircraft and equipment best adapted to profitable commercial operation.

The consequent lack of public and business confidence and support.

To remove these fundamental handicaps, the committee makes the following specific recommendations, the first for legal status and control:

The committee asks that Congress enact a civil aeronautics law providing for the establishment of a bureau of civil aeronautics in the Department of Commerce with power: To regulate civil air navigation in the United States; to license pilots and inspect and register aircraft; to develop, establish, or take over and maintain, air routes and air navigation facilities; to administer international air navigation regulations as they affect the United States; to encourage and promote civil air transport and the aircraft industry and trade, and to determine and impose civil penalties for violations of regulations. And for the recognition of the public right of free air navigation; reconciliation of the rules of water navigation with air navigation, and the correlation of the laws relating to customs, public health, imports and exports, and other laws of general scope with the civil aeronautics law to recognize carriage of goods and passengers by air.

That the several states enact statutes authorizing the municipalities to acquire, or lease, and maintain landing fields with public funds, and that for the present the other phases of state jurisdiction relative to aeronautics, be permitted to develop under the common law.

That the President submit to the Senate and that the Senate ratify with suitable reservations, the International Air Navigation Convention, which has been ratified by most of the important countries except the United States.

The committee also recommends that the Government does not engage in non-military flying activities that can properly be performed by private operation. That the Government extend the use of aircraft in non-military government activities, where aircraft may be usefully employed, such as air mail, forest patrol, agricultural, entomological and coast guard services, aerial photography, map making, etc., the operations to be conducted by private agencies under contract wherever possible.

That, under the legislation recommended, the Federal Government, without delay, provide air transportation with essential facilities, such as lighted airways, emergency fields, maps, radio, and an adequate weather service. That Congress authorize the War, Navy, and other Departments, to permit a reasonable use of Government landing fields and ground facilities for commercial aircraft operations.

Extension of Air Mail

That the Post Office Department actively encourage the establishment and extension of air-mail services, and that as rapidly as it is possible to contract with responsible private operators, the Post Office Department retire from the ownership and operation of such air-mail routes, and that it turn over to the Bureau of Civil Aeronautics its airway equipment.

That, under the direction of the President, the executive heads of the Department concerned, shall provide for the inter-departmental co-ordination of all non-military, Government air activities in order to best promote civil aviation.

Other recommendations are: That Congress appropriate for, and authorize the proper non-military agencies of the Government to purchase special types of civil aircraft and equipment, designed and constructed by private industry under the joint direction of the executive heads of all the departments concerned.

That present restrictions affecting purchases by governmental agencies be modified to permit the executive heads of the Department concerned to purchase aircraft, aircraft engines, accessories and parts, in such a way as best to promote the Government's interest, and to give equitable compensation to the manufacturer for the design-development pertaining to the materials so purchased.

That Government purchases of aircraft be arranged to conform to a definite and continuous program that will give the greatest aid to the aircraft industry. That the Government carry on fundamental aeronautical research in the interest of civil aviation. That the Government do not compete in the design, construction and major repair of civil aircraft, nor handicap civil aviation by indiscriminate dumping of aeronautical material.

Press Tools on a Production Basis

By W. E. Irish
Associate Editor, *American Machinist*

The press-tool organization — Latitude for individual thinking a company policy—Procedure in tool building, tryout and maintenance —The efficiency department—Records kept on tool performance

PIECE No. | ESTIMATOR | *ORIGINAL* | FOREMAN | DIE No. | Form Est. 672

ESTIMATE

JIG AND DIE CONSTRUCTION

Sheets ..... Date .....
Sheet No. ..... Dwg. No. ..... Type Die or Jig .....
Company ..... Name .....
Machine Time ..... Floor Time ..... Template Time ..... Tryout Time ..... Total Time .....

EDWARD G. BUDD MFG. CO.
PHILADELPHIA, PA.
STD. TIME

ITEM No.	DESCRIPTION	QUANTITY	PLANER	MILLER	SHAPER	RADIAL DRILL	LATHE	BORING MILL	SLOTTER	KELLER	GRINDER	BLACKSMITH	MACHINE TOTAL	FILE	SMALL DRILL	FITTING	HAND FORGE	LAYOUT	ASSEMBLY	FLOOR TOTAL

Fig. 7—Jig and die construction estimates

MACHINE-SHOP is the name given to that division in the organization of the Edward G. Budd Co., which is charged with responsibility for the manufacture and maintenance of all of the tools in the main pressed-steel body division.

A superintendent heads the organization and is responsible to the works manager through the latter's assistant. This superintendent has other duties, as would be shown by a more complete chart than the one given in Fig. 6, but this article is meant to cover only those activities which are directly connected with the making of the press tools for automobile bodies and their servicing in actual production.

There are three main divisions of this department, as shown, that may be further broken down into units for the purpose of discussion.

Starting with the new press tools, *floor*, signifies that section where the hand work is done and the parts assembled and fitted, and where the punches and dies are finally bedded together in the fitting-up presses and completed for delivery to the production department.

The section is composed of a number of units consistent with the volume of business, each headed by an expert diemaker and a corp of assistants. Each of the experts is directly responsible to the department assistant superintendent.

Machine, includes all work that is performed on the machine tools. Here again there are units headed under the types of machines—engraver, planer, milling machine, shaper, etc. Each of these groups is governed by an expert on the given class of machine. At the same time that he operates one of the tools he oversees the progress made on the others in his group.

In addition to the experts, there is a general machine foreman to whom they answer and who, in turn, is responsible to the assistant superintendent of the department.

When, at times, it is found necessary to have press tools built by other shops, the work is taken care of by the purchasing department with the co-operation of the machine-shop superintendent.

This provision is made in the organization, regardless of the fact that home manufacture is more economical, in order to meet emergencies that might otherwise cause delay in schedule dates and endanger the company's delivery promise to its customers.

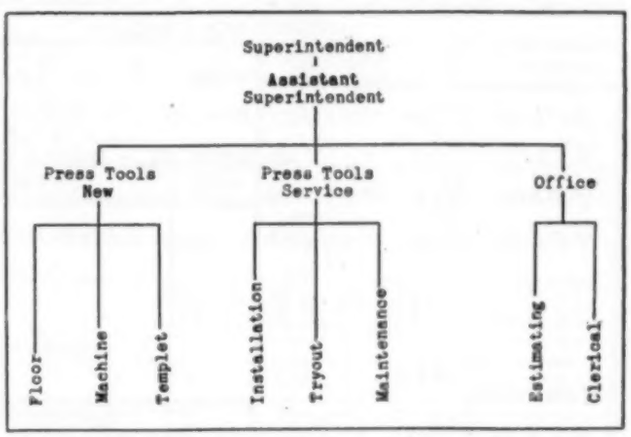


Fig. 6—The press-tool organization chart

The second of three articles on equipment organization and procedure in manufacturing press tools on a large scale. The concluding article will appear in an early issue.

Templet, as the name signifies, is that section in which the approximate blank for a job is first made, where it is altered as found necessary by tryout, and where it is finally finished and turned over to the floor department to lay out the final contour of the blanking die. This department is headed by an expert in the work, who is responsible to the assistant superintendent.

Installation, which is the section under press-tool service, consists of a group of men expert in setting tools in the presses when they have been delivered new or from die storage.

Tryout activities are connected by another group, which, in connection with the templet section, performs the trial hits on the new die. This section determines where alterations, if any, should be made and watches the tool performance until it can be pronounced as satisfactory for production. It also follows performance in production to find every possible basis for improvement in current practice and design.

Maintenance is headed by the same superintendent, who is responsible for the tryout section, and consists of performing all of the work necessary on the press tools to keep them in productive service.

This section is provided with adequate facilities for all ordinary conditions and has but rarely to call for machine work from the new-tool division except when a tool has been seriously broken and requires complete new parts.

The third group in the organization comprises the estimating work on new tools and the clerical activities of the division as a whole. Estimating consists principally of breaking down the lump figure for building a tool into its component parts and apportioning the work to the proper sections.

The organization, in general, has been developed with the point in mind of dividing the work so that individual groups can give undivided attention, respectively, to the construction of new tools on the manufacturing basis, to the installation, tryout and maintenance of these tools upon their completion and to the checking of the department's activities from the standpoint of productive man hours.

A policy of the company is to give each man in his place latitude to use his own powers of thinking and creating. Organization and procedure have both been designed, together with the system of control, to cut short of the point where any man can lean upon them in lieu of acting according to his own best judgment. Care has been exercised to see that there are no "blind alley" positions.

For the individual, this policy results in his being master of his own fortunes. For the company, there is the assurance of no "deadwood" in the organization.

Upon receipt of an inquiry from a prospective customer, an estimate is made by the main estimating department, which is under the control of the works manager's department. This estimate is based on previous experience with similar work and upon records of past performance which are derived from cost reports and data furnished the estimators from the accounting and efficiency departments. The estimate thus made is not broken down into details of tool design, but is lumped for each tool of the proposed set.

When the order is received, the tools are designed in detail in the engineering department, and drawings, together with the original estimate are sent to the office of the machine-shop superintendent.

From the company policy to give latitude to the division heads in governing their own activities, the only thing expected of the superintendent is that he stay within the lump sum appropriated and that he produce a set of tools to the drawing within the specified time to meet the company's delivery promise.

From the drawings and the original estimate, the department estimator separates the work on each tool into its component parts, using the 11x8½-in. form shown in Fig. 7. This estimate is used in connection with a continuous record kept by the efficiency department of available men and machine time, to apportion the work in the department; estimates, records and

277-681 A

DIE RECORD

CO. & MOD. ROADSTER ORDER NO. XY-200 DIE FIN. 6/9/25 DIE NO. 11712

NAME DOOR RAIL PIECE No. 71112

TYPE DIE FORM TYPE PRESS 93E

DRAW ISS. 5/15/25 DRAW No. 95611 FOREMAN ELSMAN

PATTERN	FIN.	CASTINGS REQ.	CASTINGS FIN.
95612	5/20	1	5/23
95613	5/20	1	5/23
95614	5/20	1	5/22
95615	5/20	1	5/23
	ORD		
FORGINGS			
95616	5/15	1	5/25
2X4X8	5/15	2	5/18

DATE	REMARKS	E. C. AND D. C.
	TEMPLATE OK 5/27	

	MACHINE WK.	MACHINE STD.	FLOOR WK.	FLOOR STD.	TOTAL WK.	TOTAL STD.
5/22	35	40	20	50	55	90
	35		20		55	
5/29	55	60	80	100	136	160
	90		100		190	
6/5	60	50	120	100	180	150
	150		220		370	
			50		50	
			270		420	

Fig. 8—Die-manufacturing record

Fig. 697

PRODUCTION CARD

Pc. No. Die No.

Name

Oper. Trips

Qty. Req. Company

Date	Mch. No.	Man's No.	Scrap	Clock Start	Clock Total	Actual Count

DELIVER TOTAL

TO

FOREMAN'S DIE REPORT

Pc. No. Die No.

Name

Oper. Trips

Qty. Produced Balance Company

CONDITION OF DIE

Press No. Date

Can additional stamping be made from die in present condition?

Machinist

Press Foreman

INSPECTOR'S REPORT

Repairs or alterations required to improve stampings

If necessary send stamping to Machine Shop Clerk.
Can additional stamping be passed in present condition?

INSPECTOR'S HALF-HOURLY CHECK

Day	7	7.30	8	8.30	9	9.30	10	10.30	11	11.30	12	12.30	1	1.30	2	2.30	3	3.30	4	4.30	5	5.30	6	6.30
Night	7	7.30	8	8.30	9	9.30	10	10.30	11	11.30	12	12.30	1	1.30	2	2.30	3	3.30	4	4.30	5	5.30	6	6.30

Fig. 9—The production press card

the resulting assignments passing over the assistant superintendent's desk for approval before going into effect.

One copy of the approved assignment is sent to the materials department to show where the materials are to be sent that have been made ready from the bill-of-material furnished this department from the engineering department direct. Another copy goes to each of the section foremen on the new-tool work for those parts which he is to produce, and one to the efficiency department for the continuous man- and machine-hour records. A final one is sent to the cost department as a guide for recording the costs as they begin to come in on the time and material cards. Blueprints are distributed as necessary.

With this information, the materials department issues to each section foreman the necessary materials from stock. These materials are grouped and tagged for identification, the small parts being delivered in tote boxes by means of a fleet of trucks and tractors operated throughout the plant.

Castings are started through the pattern shop on authority from the engineering department, which sends a bill of material and drawings for patterns to the shop direct. The foreman in charge of patterns makes the parts needed and orders the castings through the purchasing department. He has an assistant, whose duty it is to follow them until they are delivered at the receiving department from outside foundries. From this point, the stores department sees that they arrive at the point where work is to be done upon them.

In the process of the work, the efficiency department keeps a record on the 8x5-in. form, Fig. 8, and sends a weekly report to the foreman through the machine-shop superintendent. This report gives the man-hours which should be devoted to each tool in order to meet the delivery promise and serves to let the foreman know how he stands, telling him which one of the several tools, that may be on hand, he should concentrate on. The idea is to relieve the men in the shop from any clerical work that will distract them from direct application of their energies to building tools.

The record card is started when the work apportionment comes through from the superintendent's office, and, as shown, works as a check on patterns, castings, forgings and templets, in addition to man-hours on the machine and floor, estimated and actual, for each week.

In the man-hour column to the right are the hours required each week to bring completion at a desired date, these figures being entered when the tool is started. To the left are entered the actual hours as they are reported in.

Aside from the check on the tools in process, this comparison offers an excellent reference for the engineering department and for the estimators in future work.

As a given tool progresses, the expert diemaker, who has been given charge, begins to receive the parts, which he has previously laid out, from the machine sections, and can work with his helpers on the assembly. He carries through the operations of drilling, tapping and fitting-up to the point where the tool is ready for the fitting-up presses. The punch and die are then set up and bedded down before delivery for the tryout.

Form [illegible]

PRESS No.	FOREMAN	DATE	DIE No.

DIE-REPAIR (PRESS SHOP)

Press Shop Report

Machinist's Report

Date	Day	Night	Day	Night	Day	Night
Trouble Reported						
Repair Started						
Repair Finished						
Total						

Fig. 10—The die-repair card

After the tool has been pronounced as satisfactory with the assistance of the inspectors, it is sent down for tryout in the press in which it is to run in production.

It might be well to say at this point that the inspectors who work with the tool-manufacturing department to keep track on the quality are not held for discrepancies. They act rather as advisors and assistants to the foremen who are directly responsible for the correct manufacture of the tools. This policy of inspection and inspector responsibility is worth more than a passing consideration for it has had a very distinct effect on the successful management of the department.

The plan of making the inspector an advisor only and of holding the production foremen responsible for correct tool manufacture is the principal step that must be taken in any organization to get the desired inspection results. To tie the inspector to this responsibility is to make him at once more interested in devising means to get out of difficulty than in the work he should actually do, that of uncovering faults from a neutral standpoint that they may be properly corrected.

Upon being delivered for tryout, the tool is set up in the press and the test hits are made. In the event that changes are found necessary, it is returned to the floor foreman, who made it, for immediate correction.

When the forming-tool tryout is complete, the foreman in charge of templets, who has been present at the tryout, constructs the proper blank templet and turns it over to the floor foreman who has brought the blanking tool up to the final finishing of the cutting outline. This outline is then marked on and the steels turned over to the machine department. These are finished, fitted, hardened, bedded together in the tryout press, ground on the cutting edges, and the blanking tool is ready for delivery to production.

From this point on, the new-tool manufacturing section has nothing further to do with the tool, responsibility shifting to the maintenance section as troubles occur at the press.

For each production job there is a combination card, Fig. 9, made out and posted at the press. This card is perforated so it can be divided into its three parts after the job is run, but remains as one while the tools are in the press. When together it measures 5 in. by 11 in. It is kept in a holder on the press.

The upper portion contains information pertaining to production. The center portion is filled in by the production foreman, who inserts remarks concerning the condition of the tool at the end of the run, or upon failure during the run. This portion is then signed by the production foreman and also by the maintenance machinist, the point being to assure an understanding between the production and maintenance departments.

EFF. 545-A—S

DIE RECORD

DIE .....

ORDER # ..... DATE ISSUED ..... SCHED. ..... STYLE .....

PIECE # NAME CO. MODEL PRESS

OFF EST | E C EST | TOTAL EST | FORE | TEMP.

SHOP EST MACH. | FLOOR | TEMP. | TO | TOTAL | CSTGS.

ACTUAL TIME MACH. | FLOOR | TEMP. | TO | TOTAL | EXC.—

DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	M	D	T	R		TOTAL EXCESS

Fig. 11—The die-performance record

This one point can be made a source of perpetual argument over the condition of a press tool, or can be turned into one of actual assistance to both, as well as to the company's fortunes, in direct relation to the manner in which it is handled. The double signature is an excellent plan to bring any discussion concerning a tool to a point so it can be settled at once.

The bottom portion of the card is used to record the inspector's contact with the work and to provide an opportunity for this department to make suggestions for betterment or precautions to preserve quality.

When repairs are needed, as agreed by the production department, the inspector and the maintenance machinist, the tool is tagged for the repair department and a 6x4-in. card, shown in Fig. 10, is made out and sent to the repair department office.

Here the work is scheduled and a careful check kept on performance. Upon completion of repairs, the tool is returned to the press or sent to storage in the proper department to await its next call for production work in the presses.

In the office of this section a card record is kept on each tool in service. The 8x5-in. form shown in Fig. 11 is used for this purpose and is started at the time the tool is first delivered to production. Aside from the heading, there are two sets of columns. One shows the date a tool is sent in for repairs and the other the man-hours required to put it back into serviceable condition. Discussion of the value and many applications of this information is unnecessary, as its advantages are obvious. The record is perpetual and is kept in the active file for the life of the tool.

Press tools, in the Budd Manufacturing Co., are a business in themselves, a business conducted with every possible thought given to speed, economy and permanence in making the equipment that must be correct in order to produce automobile bodies economically for the trade, in quantities to schedule and of an unquestionable quality.

Thread Standardization as Related to Cost and Delivery

By C. W. Bettcher
Secretary and Sales Manager, The Eastern Machine Screw Corporation

Two primary classifications—Review of the work already accomplished—Unnecessary expense resulting from special threads—The screw that Jack drew—Gradual disappearance of the V-thread

IN SPITE of the popularity, wisdom and economic value of standardization, some individual designers and manufacturers still have a tendency to believe their problem is the exception to the rule or else do not provide for the proper supervision of screw-thread selection. They do not seem to realize the hardships and delays that special threads impose on production and cost.

The use of a screw thread may be primarily divided into two classifications, to hold two or more parts firmly together, and to provide a control of the movements of two related parts.

Under the first come the usual bolts, screws, nuts, etc., with a subdivision of various pipe requirements Under the second come lead screws, jack screws, valve spindles and such adjustment or control threads.

Let us review the work accomplished by the National Screw Thread Commission and see how this will help us to conveniently standardize without hardship to anyone and with decided savings to all. The investigation has been carried on in such a way, and the classifications have been presented in such a manner, that the recommendations can be followed without any changes on the part of the majority of users and producers of threaded parts. They can be advantageously followed by the small minority which still, through accident or from tradition, use special threads that can readily be changed to conform to recommended practice. Certainly, there seems to be little reason why, in the design of new equipment, machinery, tools and other devices requiring threaded parts, thread selection cannot be made from the National Screw Thread Commission's recommendations.

Let us take up the class of threads mentioned in the first class. The form of thread recommended is the well known U. S. or Sellers form in which the included angle is 60 deg. and there are flats, both top and bottom, equal to $\frac{1}{8}$ of the pitch, $\frac{1}{8}$ of the distance from a point on one thread to a corresponding point on the next thread. This form is the most easily reproduced of any of the thread forms in existence and, from a mechanical standpoint, has proven to be the most satisfactory. It has, likewise, been adopted by most of the other manufacturing countries with the exception of Great Britain.

The National Screw Thread Commission's report provides two main tables of thread sizes. One is known as the National coarse-thread table of sizes and is made up as follows:

From $\frac{1}{4}$ in. in diameter and up, the sizes and pitches are exactly the same as the well known U. S. standard table. Below $\frac{1}{4}$ in. in diameter, the sizes are taken from the standards established by the A. S. M. E. wherein the diameters are specified by a number and wherein the pitches selected are relatively coarse but generally used for that diameter.

This coarse-thread table is for general use in engineering work, in machine construction where conditions are favorable to the use of bolts, screws and other threaded parts and where quick and easy assembly of parts is desired, and where the fastenings are not subject to a high period of vibration or any work that does not require the use of a fine-pitch thread.

The fine-thread table is made up of thread sizes which, from $\frac{1}{4}$ in. and up, are in accordance with the regular S.A.E. recommendations. Below $\frac{1}{4}$ in. in diameter, fine threads consist of the regular A.S.M.E. numbered sizes of the finer pitches, the fine-thread series of the A.S.M.E.

Recommended Uses of Thread Table

This table is recommended for general use in automotive and aircraft work and for use where the design requires both strength and reduction in weight, where the period of vibration is quite high and where special conditions require fine threads, as on large sizes where sufficient force cannot be secured by hand to properly tighten a screw or bolt of coarse pitch. These fine-pitch screws do not work loose so easily under vibration and have increased strength for a given outside diameter, due to the increased root diameter.

In this report we have two thread tables that consist of standards already adopted but classified clearly in accordance with the use to which the thread will be put.

Complete tolerances are provided for screws and nuts and these tolerances are classified into five distinct classes of screw-thread fit which insure definite degrees of either ease or accuracy of assembly as required. These fits are known as loose, free, medium, close and wrench.

Realizing that there are quantities of threaded parts, such as hub and radiator caps, or threaded collars on machine tools, where diameters are larger, pitches are finer, and length of engagement shorter than the regular bolt and nut practice, the Commission has recommended that the selection of pitches for such threads be made from 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 28, 32, 36, 40, 48, 56, and 64 threads per inch.

Even with this wide range, decided savings can be accomplished in regard to the cost of tools and master tools. A complete system of tolerances for the different kinds of fits is provided for these different pitches. In selecting diameters it is desirable, in other than even inches, to make the fraction halves, quarters, eighths or sixteenths. The likelihood of finding tools available will be in the order we have placed these fractions.

Complete tables are given covering the National (Briggs) taper pipe threads, straight threads, locknut threads and fire-hose connection threads.

In this report, therefore, we have provided for us thread specifications covering a wide range for any possible thread requirements. We cannot emphasize too strongly the importance to the Nation, from an economic standpoint, as well as the benefit to be derived in case of war from a universal adherence to, and understanding of, the tables of thread sizes recommended therein.

Take the case of some new piece of equipment where either the designer or the draftsman accidently, or otherwise, specifies the diameter, pitch or thread form of certain threaded parts wherein these features do not conform to anything that has been used heretofore. It might seem that such a condition would be very unlikely to arise, but it is happening every day.

The blue prints are made and preparations to manufacture are begun. When it comes to providing the threaded part, it is found that special tools are required. These are obtained at an extra expense and usually after a considerable delay. It is a question how many duplicate tools should be required in case they do not last for completion of the number of parts required. In case enough are not ordered, production will be held up while additional quantities of the special tools are obtained. If too many tools are ordered, something is left over as an idle investment.

Special threads mean that both male and female gages will have to be specially made, as nothing, already in existence, can be used and considerable planning and work is involved. Suppose the interpretation of requirements is such that the tools for cutting the male and female threads result in the parts not assembling properly. Suppose the equipment, in which the special threaded parts are used, is eventually installed at a distance from where it was manufactured and that a replacement of one of these threaded parts is necessary.

It will be impossible for them to be duplicated near at hand and costly delays will result. If the threads are damaged slightly there is no way to conveniently re-tap or re-thread locally.

Suppose, on the other hand, and this procedure is gaining in popularity, some individual in the organization where the equipment was made was charged with the responsibility of seeing that no threaded parts were manufactured or used in the assembly of equipment until the thread specification was approved. This approval would consider whether an existing standard thread could be used and whether the selection of the thread could conform to tools already provided for.

In large manufacturing plants, making their own threaded parts, such supervision is an important factor in reducing the investment in tools kept in stock.

Next, let us consider what happens to the manufacturer of threading tools when he is called upon to supply tools for cutting special threads. The chasers for a self-opening diehead make a good example. To manufacture chasers for cutting special threads requires special tools, taps, hobs, or hob cutters. These tools must be made up specially for the purpose. To do this, it is necessary to make special tools from which these master tools can be made.

We could write a parody on the old nursery rhyme of "The House that Jack Built," running something like this:

The Screw that Jack Drew

This is a view of the screw that Jack drew.

This is the screw that looks like the view of the screw that Jack drew.

These are the chasers that look so true that cut the screw that looks like the view of the screw that Jack drew.

These are the hobs with their beautiful knobs that made the chasers that look so true that cut the screw that looks like the view of the screw that Jack drew.

This is the tool that made the hobs with their beautiful knobs that made the chasers that look so true that cut the screw that looks like the view of the screw that Jack drew.

This is the man so weary and worn who ordered the tool that made the hobs with their beautiful knobs that made the chasers that look so true that cut the screw that looks like the view of the screw that Jack drew.

Jack may be a good designer but think of the endless trouble and expense he is making for everyone.

There has been a thread system in existence, for a great many years, which, fortunately for all concerned, is gradually dying out. It is known as the V-thread system. It is surprising how many manufacturers still specify the V-form of thread. The U. S. form would be much more satisfactory. Let us stop to realize what a V-thread means. To the threading-die and tap manufacturer it is a nightmare. It not only means special tools to produce it but special tools to make the special tools. The cutters, hobs chasers or dies and taps all must have their turn in the hardening fire. Think of the difficulty in preserving the sharp V-points when transferred from tool to tool!

Another feature of threaded parts that deserves comment, and possibly criticism, is in the case of male threads where the draftsman shows a full thread close to a shoulder. Proper provision for necking the piece would change this requirement from a very difficult one and yet not change or affect the assembly.

Among the threads mentioned in the second class at the start of the article we have the acme, buttress, square, and others. It is hardly possible to attempt any standardization between diameter and pitch at the present time. However, when planning to use such threads, it is important to first get in touch with the die and tap manufacturer regarding tools that have already been produced and could meet the requirements.

It is not exaggerating to estimate that every prominent manufacturer of taps and dies carries at least 1,500 specials and standards in stock and that only 200 of these sizes have a stock turnover in a year. The users of such tools could simplify their own stock and reduce costs by more careful consideration of standardization and by a determination to avoid the use of special threads.

This is an age of standardization. Let us not neglect the screw threads or overlook the saving that consideration of the subject will bring about.

The Vital Need for Greater Financial Support to Pure Science Research

An address by Secretary Hoover before the American Society of Mechanical Engineers, as the first Henry Robinson Towne lecturer

I WISH on this occasion to say something upon our great national need of a much more vigorous support to pure science research in our country.

There is no body of men more interested in the advancement of pure science than our engineers, for the engineering profession is built upon the application of scientific discovery. And of larger vision, if we would command the advance of our material, and to a considerable degree, of our spiritual life, we must maintain the earnest and organized search for truth. We could well put such an appeal wholly upon moral and spiritual grounds; the unfolding of beauty, the aspiration to knowledge, the ever widening penetration into the unknown, the discovery of truth, and finally, as Hauxley says, "the inculcation of veracity of thought." All are ample justification for our finding dollars to keep these searchers alive. But as I am proposing to support an appeal for dollars, I propose to discuss the dollars' results as well.

Research in the biological and physical sciences takes two forms; industrial research, (which is the application of science), and research in pure science. Obviously there must first be a pure science before there can be an application. I am aware that there is a twilight zone between them, but no scientist has difficulty in finding the borders.

While we have in recent years developed our industrial research upon a scale hitherto unparalleled in history, we have by no means kept pace in the development of research in pure science. We have an increase in some ten years from 100 to over 500 laboratories engaged upon search for applications of known scientific fact and law. These results have been magnificent. But all these applied science laboratories are dependent upon the raw material which flows from the laboratories and men engaged in pure science. And the industrial investigators are the first to demand more support to pure science.

Not only is our nation today greatly deficient in the number of men and equipment for this patient groping for the sources of fundamental truth and natural law, but the sudden growth of industrial laboratories has in itself endangered pure science research by drafting the personnel of pure science into their ranks—depleting at the same time not only our fundamental research staff, but also our university faculties, and thus to some degree drying the stream of creative men at the source. Thus applied science itself will dry up unless we maintain the sources of pure science. This is no complaint against our great industries and their fine vision of the application of science. It simply means we must strengthen the first line of our offensive. The day is gone by when we can depend very much upon consequential discovery or invention being made by the genius in the garret. A host of men, great equipment, long patient scientific experiment to build up the structure of knowledge, not stone by stone, but grain by grain, is today the fundamental source of invention and discovery.

Compared with other expenditures of far less importance to human welfare, the amount of money annually devoted in the United States to the aid of investigators and investigation in pure science is absurdly small. It is less than one-tenth what we spend on cosmetics. We have indeed some fine foundations for pure scientific research. The Carnegie Institute, the Smithsonian Institution, the Rockefeller Institute, and the many other research activities of much more limited but special endowments, the work of our universities, together with the work of the National Research Council and our government agencies have shown fine accomplishment in this field. But the whole of the income available from these sources for research in pure science certainly does not exceed $10,000,000 a year—whereas in the professional schools of our universities, in technical and agricultural colleges, and experiment stations, in industrial laboratories and in our government bureaus we probably expend today $200,000,000 a year upon applied science research.

Gives to Pure Science Proportionately Smaller

The wealth of the country has multiplied far faster than the funds we have given for these pure science purposes. And the funds administered in the nation today for it are but a triviality compared to the vast resources that a single discovery places in our hands. Men of science know, from their own experience, how seriously scientific work has been impeded by lack of resources, and they will appreciate how great, in the aggregate, must be the resulting loss to the nation and to the world.

The progress of civilization, as all clear-thinking historians recognize, depends in large degree upon "the increase and diffusion of knowledge among men." It is not merely a question of applying present-day science to the development of our industries, the reduction of the cost of living, the eradication of disease, and the multiplication of our harvests or even the diffusion of knowledge. We must add to knowledge, both for the intellectual and spiritual satisfaction that comes from widening the range of human understanding, and for the direct practical utilization of these fundamental dis-

coveries. A special study in an industrial laboratory, resulting in the improvement of some machine or process, is of great value to the world. But the discovery of a law of nature, applicable in thousands of instances and forming a permanent and ever available addition to knowledge, is a far greater advance.

If we were to survey the nation we should find that the technically trained men engaged in pure science research fall into two main groups, on one hand, those supported in the great pure science research institutions, and on the other, those in our universities, or engaged in individual investigation. The number supported by our pure science research institutions, such as the Carnegie, Rockefeller, Smithsonian, and others probably does not exceed 500 technically trained men. Those engaged in pure science research in our universities or upon their own resources probably do not exceed 5,000, and most of these devote only part of their time to this work. And there are some men in our industrial laboratories who are engaged in pure science work. It is an interesting contrast that the scientifically trained personnel in our applied science investigation today probably exceeds 30,000.

Support Needed for Three Types of Research

The problem as I see it is to secure much larger support—

First, to our university men, in order that they may be able to give a large proportion of their time to research, and that our universities may increase the number of men.

Second, to co-ordinated research for certain definite purposes.

Third, to the pure science research institutions.

It is on the men in independent research and in our educational institutions that the great burden of scientific advancement must always rest, and from them that the inspiration of the younger generation of oncoming scientific workers is derived. What we need above all things is the better support of these men. They should not, by the necessities of living and the cost of equipment, be forced into our industrial laboratories. Those men who show an aptitude for research should be less engulfed in teaching. Often their productivity can be greatly aided by being released from teaching and administrative demands, and endowed in research positions. Much can also be done by providing them with instruments, skilled assistants, measurers, computers, stenographers, and all the aids that the nature of their researches and the most economical use of their time may demand.

There is no price that the world could not afford to pay these men who have the originality of mind to carry scientific thought great strides—and they wish no price. They need opportunity to live and work. No one can estimate the value to the world of an investigator like Faraday. Our whole banking community does not do the public service in a year that Faraday's discoveries do us daily. As national assets, men of his type, even when much less gifted than Faraday in the past and Millikan today, are beyond valuation, and no effort should be spared to facilitate their work.

The universities in which most of them are employed are not to be blamed for this, because they do maintain vital interest in research and they would be glad to devote much larger sums to its support if the pressure of other demands would permit. In seeking assistance elsewhere the investigator encounters ample good will, but sadly inadequate means. We may make these academic posts so attractive to the student of science that he will seek and occupy them permanently because of the opportunities they afford him to advance knowledge by original research without anxiety for bread and family and equipment. It is true that money cannot buy genius, but many a genius in science has defaulted because he has had to eat.

Aside from direct support to these men there is another method of organization of research among them that is no less in need of support. This is co-ordinated research in specific directions by men in different localities—again men mostly in our universities. Some of these are broad inquiries, demanding the joint consideration of specialists from various fields of science. Others are of narrowed scope but of such character or magnitude that the combined efforts of many workers are essential for their solution. The National Research Council has organized many co-operative investigations. Such organized campaigns against the unknown are few and far between in our country, for but few men have had the vision to give them financial support.

The third type of pure science research that requires much more liberal support is the special institution. The recent appeal of the Smithsonian for additional endowment to enable them to support a larger staff so that they may properly compass that fraction of the field of science which has been their province should have the support of every citizen. The Smithsonian has been peculiarly the architect of scientific investigation in our country. Much of the work we have in progress today has been inspired from this great pioneer of all American research.

It is unfortunately true that we can claim no such rank in pure science research, as that which we enjoy in the field of industrial research. Instead of leading all other countries in the advancement of fundamental scientific knowledge the United States occupies a position far in the rear of the majority of European nations. A list of the awards of the Nobel prizes to men of various nationalities reveals the small proportion of first minds that we support. Other tests lead to the same conclusion—namely, that the number of first-rank investigators developed in the United States is far below what our population, education and wealth would lead one to expect.

Why America Has Not Kept Pace with Europe in Pure Science Research

The difficulty we experience in securing a place in science beside the nations of Europe can hardly be due to a lack of men of innate ability, judging from the leading part already played by the United States in finance, in architecture, and in applied science. It results partly from the fact that American civilization is only beginning to emerge from the pioneering stage, and partly from the financial and other inducements which so often lead talented men reluctantly to accept well-paid industrial positions instead of poorly-paid academic and research posts.

We have prided ourselves on our practicality as a nation. Would it not be a practical thing to do to give adequate organized financial support to pure science? And if by chance we develop a little contribution to abstract learning and knowledge, our nation will be immensely greater for it.

The Weighing Scale —An Instrument of Precision

Building a large railroad track-scale—Ponderous in weight but simple in construction—Parts must be delicately balanced — The operation of sealing

By Ellsworth Sheldon
New England Editor, *American Machinist*

THE CASUAL observer who sees in the yard of factory or storehouse, beside the highway or along the railroad tracks, the conventional box-like structure bearing the familiar legend "Standard Scales," though he may well know its purpose and even be adept in its use, gives little thought to the means by which the weights of heavy loads upon the platform are transmitted to the graduated beam in the box, and in transmitting reduced to proportions that enable the weigher to balance a 200-ton locomotive by merely sliding a small piece of metal along the beam. That there must be a carefully calculated mechanism is obvious; that it may be as precise and delicately balanced in its way as is that of a watch is not so apparent even to those wise in mechanical matters.

To him of an inquiring turn of mind who has sought to look beneath the platform and discover for himself just how the load is transmitted the ponderous levers, some of them a ton or more in weight, with their rigid supports and sturdy connections convey the impression of a massive solidity far removed from delicacy or sensitiveness.

Yet, heavy and ponderous though it may be in order to withstand the shock of heavy trains passing over the platform or to sustain enormous loads in the performance of its normal function, the mechanism of a 200-ton track scale is so accurately constructed and so delicately adjusted that a 20-lb. weight placed upon the extreme corner of the platform will cause a perceptible deflection of the weigh-beam.

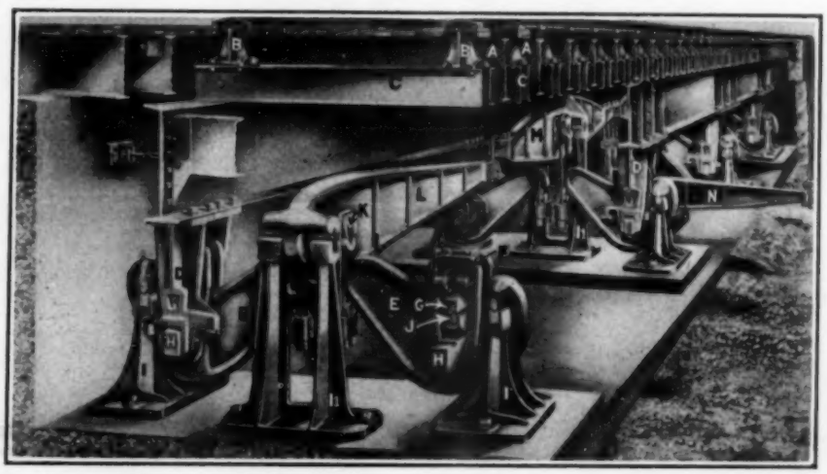


Fig. 1—Under the platform of a 200-ton track scale

The weigh-scale is in principle nothing more than a dividing machine. Each unit receiving its share of the total load passes a portion of it to the next unit, and that portion in passing successively through other units, each with its predetermined factor of reduction, is finally reduced until the amount that eventually reaches the weigh-beam is but a small and easily handled component of the total weight.

If a beam of uniform section be suspended at a point coinciding exactly with its center of gravity and in such manner that it is free to swing about that point in a vertical plane it will be in equilibrium and will remain in any position—horizontal, vertical, or any angle between—in which it may be placed. If equal weights now be hung from the beam on opposite sides of and equidistant from the point of suspension its state of equilibrium will not be disturbed. If now the center support be moved so that one end of the beam projects ten times as far beyond it as the other, a weight of one pound upon the long end will balance a weight of ten pounds upon the short end.

If instead of using a ten-pound weight we connect the short end of the beam to the long end of a second beam of the same proportions, the weight of one pound on the long end of the first beam will balance a weight of 100 lb. upon the short end of the second beam. It is exactly this principle of extended multiplication—or division—that is applied to making large scales.

As it would be impossible to secure a comprehensive photograph of the mechanism of a track scale in service the wash drawing, Fig. 1, used by the manufacturer in the preliminary work, is here reproduced to show the construction and assembly.

Ordinarily there are two tracks passing over the platform of a track scale, known respectively as the "live" and the "dead" rails. In Fig. 1 the dead rails rest upon the transverse I-section beams *A* that span the pit and are in turn supported by the concrete or masonry side-walls thereof, so that a train in passing over the scale imparts no shock to it and no load is

Photographs and data by courtesy of the Howe Scale Co., Rutland, Vt.

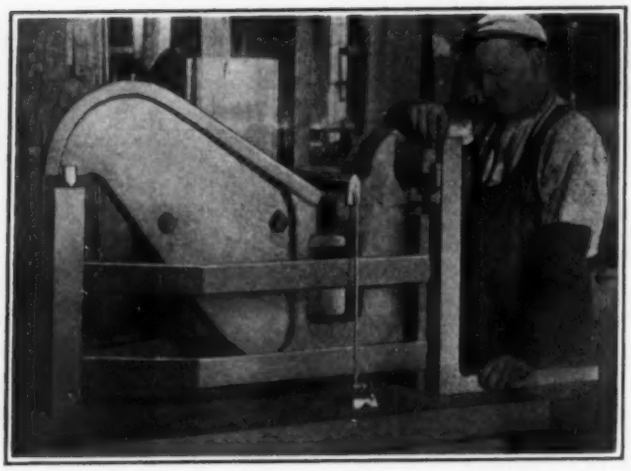


Fig. 2—One of the main levers in the making

imposed upon the levers. In such a scale the platform is stationary and is bolted directly to the I-beams.

The live rails rest upon the "chairs" *B*, and these in turn rest upon the double channel-beams *C*, the ends of which bear upon the deep-sectioned I-beams that extend longitudinally through the pit. The lower I-beams, the channel-bars, chairs and live rails are bolted and riveted together into a rigid unit known as the "weigh-bridge."

The weigh-bridge rests upon saddles *D* (eight in number in this scale) that span the main levers *E*, the latter being connected by links *F* to the bearing blocks *G* in which are set pieces of glass-hard steel to receive the load. The bars *H* pass through, but do not touch, the levers *E* (the opening may be seen in Fig. 2) and are adjustable within the saddles by means of tapered wedges in order that the bearing blocks to which they are connected may be set and maintained in exactly horizontal position after the scale is installed. The object of this apparently complicated suspension at each of the eight principal load points is to prevent the inevitable end movement and vibration of the weigh-bridge from reaching and eventually destroying the pivots.

The pivots, or "knife-edges" as they are commonly called, are made of a grade of tool steel especially adapted to withstand heavy crushing strains and are machined by grinding to present a sharp, straight edge to the hardened steel bearing blocks. They are not knife edges in fact, as the angle approaches 90 deg., and in many scales they are actually square bars. In no case, however, is the corner rounded.

In each of the main levers there are three of these pivots. The outer one, in the short end of the lever, rests upon the bearing in the fulcrum stand *I*, which, with its seven companions and the four central stands *I*-1 sustain practically the entire weight of the structure and load. The pivot at *J* bears the load delivered to it by the weigh-bridge and its connections, while the pivot in the long end (not visible in the picture) delivers a portion of the load upon that particular lever, through its connections to pivot *K* of lever *L*, called the "end extension-lever."

By referring to our experiment of the simple lever with the long and short ends it may be reasoned out quickly that the load delivered to pivot *K* is but a small portion of the load upon pivot *J*, and that the bearing block has to support the remainder. The eight pivots *J* must not only sustain by far the greater part of the weight of the weigh-bridge and load, but, owing to impact, uneven loading of cars and other causes, each one must be capable of shouldering a temporary load equal to at least 50 per cent of the total capacity of the scale. All the other pivots take the load in decreasing ratio, but all must be calculated to bear their proportionate share of overload from the above causes.

In Fig. 2 may be seen one of the main levers set up on an aligning plate with the pivots in place. Not only must the edges of the three pivots be accurately parallel in two planes but the middle one must bear a certain definite and exact relation to a straight line drawn lengthwise of the lever and touching the edges of both outer pivots. This has to do with the peculiarity of a scale called "range," which will be explained later with reference to its application to the weigh-beam.

Returning for a moment to Fig. 1, the end-extension *L*, of which there are two in this scale, deliver their respective loads to the middle extension levers *M*, also two in number, which have a double function. Each of the levers *M* has four pivots; one at each end, one at the exact center, and one a short distance removed from the center.

Considering first the center and end pivots the lever is of what is called the "even balance" type—that is, it does not reduce but transmits to the fifth, or transverse, lever *N* the exact load delivered to it by the pair of main levers at the opposite end. Considered in its

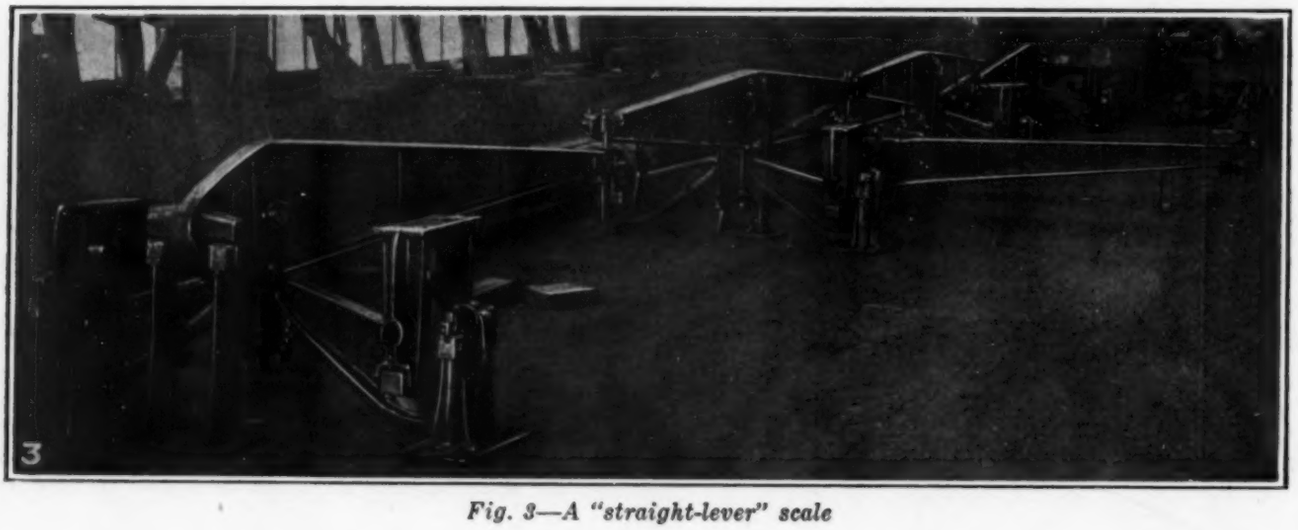


Fig. 3—A "straight-lever" scale

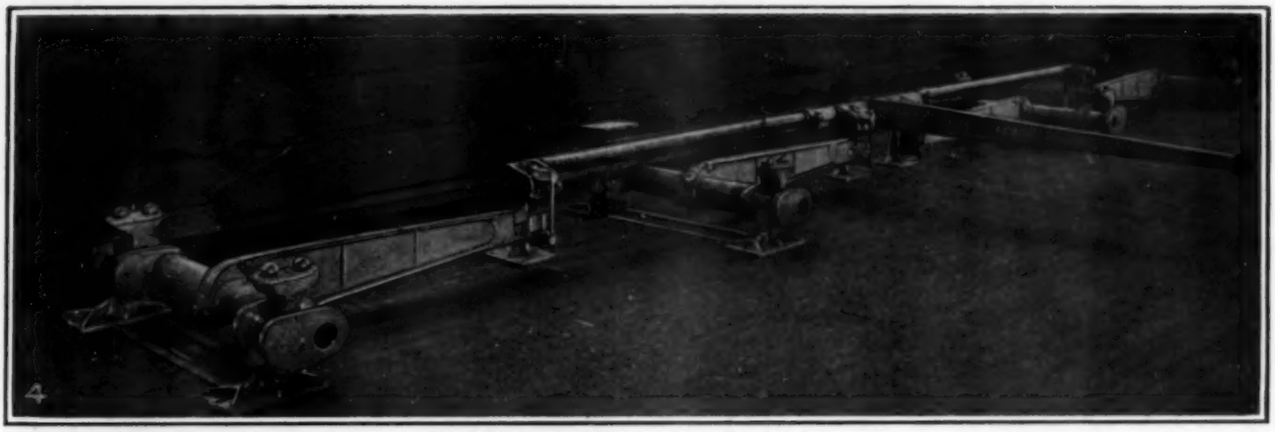


Fig. 4—A "pipe-lever" scale

second capacity it is a reducing lever, for the fourth pivot receives the load of the second pair of main levers, and the distance from the center to the fourth pivot is so calculated that the effective load delivered upon the end pivot at the right from the added burden upon the fourth pivot is exactly equal to that delivered to the end pivot at the left through the end extension lever from the first pair of main levers.

It will thus be seen that the weight of the load upon the weigh-bridge is transmitted in constantly diminishing ratio to the short end of the transverse lever *N* that extends under the beam-box, and from the long end of that lever, through a connection known as the "steelyard rod," to the short end of the weigh-beam in the box.

Little Finishing Required

Notwithstanding the extreme accuracy and sensitiveness of a large weighing machine there is but little actual machine work upon its parts in comparison with their great size. Pedestals must be planed, the adjusting wedges accurately fitted, and many of the smaller parts are produced upon lathe, planer or milling machine, but the levers themselves require little finishing other than sand-blasting and painting. The small ends of the large levers are planed to receive the "nose-irons," which are fitted to slide in dovetailed guideways and are provided with adjusting screws and micrometer dials to facilitate minute adjustments.

Dovetailed tapered grooves are planed across the main levers, into which the hardened and ground pieces of steel that are the pivots are fitted and driven. In the extension levers where the pivots pass clear through the casting and take a bearing upon both sides of the lever a hole is cored through the casting and this is afterwards broached out to receive a box-shaped steel shoe into which the pivot is keyed.

All pivots rest upon bearing blocks of hardened steel that are finished by grinding. Much of the fitting is necessarily hand work, and because of the fact that upon the perfection of the pivots and bearings depends the life and accuracy of the scale the fitters are expert workmen with long years of experience on this particular job.

All scales are set up and tested before shipment, and this operation is one of the most interesting. "Testing," however, is a word that has no place in the vocabulary of the scale maker; the operation is always called "sealing."

The sealing room at the Howe plant is a large building of brick, detached from the rest of the factory and containing no moving machinery. The floor is of plank, laid in cement. Vibration is the deadly enemy of the "sealer," and every precaution is taken to avoid it. The temperature of the room is maintained as nearly at 70 deg. F. as is possible, for the reason that fluctuating temperatures while the sealing is in progress would mean that the large and the small parts were not necessarily at the same temperature, and most annoying complications would result.

Large scales are of two types; the "straight-lever," and the "pipe-lever." Figs. 3 and 4 show the working parts of each type set up on the floor of the sealing room ready to receive the temporary platform or weigh-bridge, as the case may be. The pipe-lever construction differs from the straight-lever considerably in appearance but none at all in principle.

A pipe-lever scale is shown in Fig. 5 with the temporary weigh-bridge in place and upon it two test-cars, each of 20 tons weight and themselves sealed so that their weight is known to be exact.

One of the hardest problems of the scale maker is to prevent any horizontal movement of a platform from reaching the pivots. A vertical movement (the normal movement) causes only a slight tilting or swinging of the knife-edges upon their hardened steel bearer and is practically without friction, even though the knife-edges are under enormous pressures at the time. Any sliding or scraping movement of the sharp corners would put the scale out of business immediately.

A certain amount of horizontal movement of the platform is inevitable. The edges of the latter must

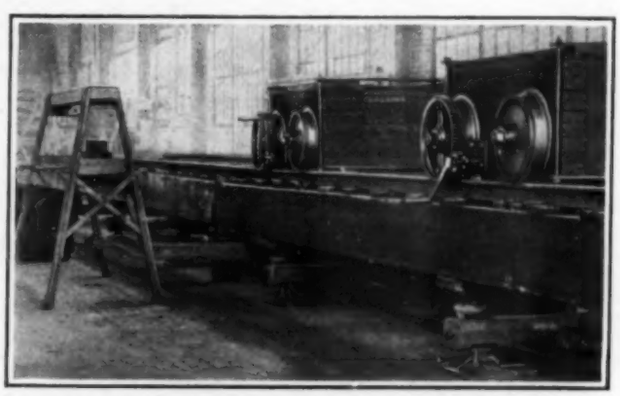


Fig. 5—A 200-ton track scale with temporary weigh-bridge

not touch the sides of the pit, else the scale would not weigh correctly. Bumpers are provided to take the shock of an oncoming load, but after the latter has come to rest the platform must settle back to its central position, out of contact with everything but the saddles, and during the movement it must not have disturbed the knife-edges.

In Fig. 1 we have seen how this is accomplished through the somewhat complicated system of link suspension. In Fig. 6 the same result is reached by placing the platform or weigh-bridge upon a number of chilled iron balls. The balls rest in concave pockets having a radius of concavity considerably greater than the radius of the balls so that a movement of the platform meets with a constantly increasing resistance as the balls roll up the curved sides of the pockets. When the load comes to rest the platform settles back to its original position as the balls roll to the lowest point of the pockets.

Another view of the sealing room, Fig. 7, shows a lighter scale; one of the type that for convenience and from the use to which it was originally put is called a "hay-scale." During the operation of sealing the weights of 100, 200, 300 and 500 lb. have been placed, one at a time, upon the platform by means of the crane, and as each additional weight is placed, the sealer notes the weight registered and makes correction in the mechanism as necessary. There is never a doubt as to the accuracy of the standards, as each weight is itself sealed once every year.

The sealing operation is neither an easy nor a speedy one; accuracy alone being considered. It may require three or four hours to seal such a scale, or it may require as many days; depending upon the degree of accuracy attained in producing the parts as well as upon many other conditions, some of which are not under the sealer's control.

At the beginning of the operation when the sealer takes over the job from the erector (the sealer is a specialist and does nothing else) he places a 500-lb. weight upon the center of the platform and makes a notation of the amount registered at the weigh-beam. As the weight is known to be exact and the weigh-

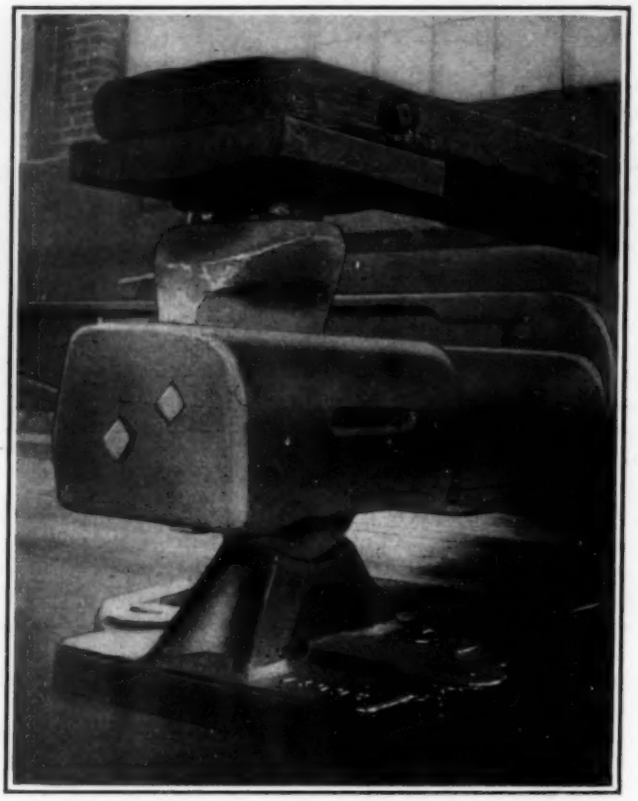


Fig. 6—One of the main load points, 200-ton track scale

beam and its connections are a part of the sealing room equipment, never being taken therefrom, the indicated weight must be 500 lb. or there is something wrong with the scale.

Having corrected any existing error, the weight is next moved to each corner of the platform in turn and an observation recorded at each move. A variation of several pounds may be registered as the weight is moved about, and it is the sealer's job to make the scale register the same, regardless of the position of the load. This test is repeated for each added weight until the capacity of the scale is reached.

Correction may involve turning up an adjusting screw, altering some of the connections, or, possibly, dismantling the scale to replace some part. More often it is accomplished by the mere honing of some one of the many pivots. It is difficult to believe that a few minutes' work with a hone upon a hardened steel pivot will effect a variation amounting to several pounds at the weigh-beam of a scale the ultimate capacity of which is 100 or more tons, but such is the case.

Before erecting a large scale each lever is sealed individually by mounting it upon a special pedestal, or bearing block, attaching the nose-iron (in which is the end pivot) to the steelyard rod of the weigh-beam and hanging various known weights upon the middle pivot.

The weigh-beam must register each successive weight correctly before the lever is finally passed for erection in the scale assembly.

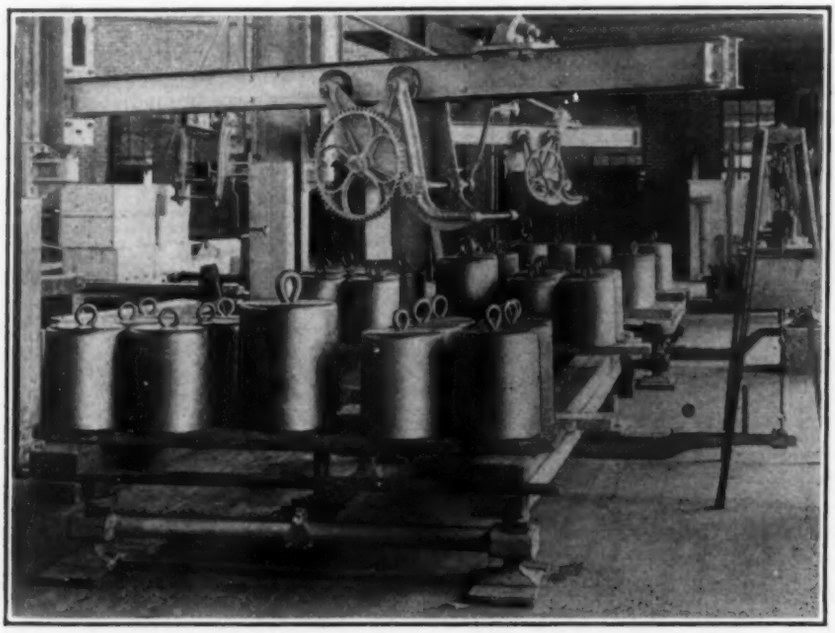


Fig. 7—A hay-scale with the sealing completed

Normal Pitch—The Index of Gear Performance

By G. M. Eaton

Chief Mechanical Engineer, Westinghouse Electric & Manufacturing Co.

Operating conditions of gears in electric locomotives—Experiments in eliminating vibration and noise—Disturbance introduced by action of connecting rods—Effect of lubrication

THE methods outlined were developed and are in commercial use at the R. D. Nuttall Co. They apply particularly to gears in heavy duty, as, for example, in heavy traction electric locomotives. The fundamental principles, however, apply to any involute gearing.

The discussion is based upon the main gears of electric locomotives recently supplied to the Norfolk and Western Railroad Co. by the Westinghouse Electric & Manufacturing Co. and the American Locomotive Works. This installation was chosen because of the exceptional combination of service conditions, rather than because extremely quiet operation was essential.

Effects of Motoring and Regenerating

When the locomotive is hauling its train up a grade, the pinion drives the gear. This service will be referred to hereafter as "motoring." This service must be performed with either end of the locomotive leading; that is, the pinion drives the gear either clockwise or counterclockwise. When the locomotive with its train is descending a grade, the main motors supply the braking resistance and return energy to the power line. This service will be referred to hereafter as "regenerating." While regenerating, the gear drives the pinion, and this drive, again, may be either clockwise or the reverse.

The connecting rods produce an external cyclic disturbance. The discussion will show that quiet performance is harder to achieve in this combination of service than is the case with a simple one-way drive.

When the normal pitch of the driven gear is measurably longer than the normal pitch of the driving gear, the tendency toward premature engagement may become more pronounced. If, under this condition, the angular velocity is high, and if the teeth are soft and comparatively rigidly associated with masses of great inertia, the flank of the driving tooth and the tip of the driven tooth will undergo permanent distortion and wear. If, however, the teeth have been sufficiently hardened by heat treatment to enable them to sustain within their elastic limit, the forces set up by this dynamic engagement will be shortened to slightly more than one normal pitch.

This readjustment of the relative angular positions of the driving and driven gears can occur in the brief time element allowed, without setting up destructive locally applied forces, only by virtue of the elastic characteristics of the entire associated structure. When the elastic conditions, masses, and frequencies, bear to each other a relation permitting resonance to occur, the situation becomes serious. The engineer must therefore predetermine as far as possible that the relation of these fundamentals is satisfactory. In certain one-way drives where unsatisfactory operation was recently investigated and corrected, the basic reason was found to be a normal pitch of the driven gear longer than that of the driving gear.

In installations where the pinion drives the gear and little or no back-driving occurs, the sensible course is to avoid dipping into the difficult and somewhat indeterminate investigations of resonant response to premature tooth engagement. This may be approached by making the normal pitch of the driven gear shorter than that of the driving gear, by an amount sufficient to compensate for the deflection of the active teeth. The limits should be set at values also insuring that premature engagement will be avoided even when the most undesirable extremes of commercial tolerances chance to be cumulative.

In the locomotive installation under discussion, however, the issue is more complicated. In all the illustrations, the pinion has been shown as the driving gear, which is the motoring condition. But every departure from a precise equality of normal pitch of the gear and pinion which may be adopted to improve motoring performance serves to deteriorate the performance while regenerating. The best overall performance therefore becomes a compromise and involves a review of the relative motoring and regenerating mileages and loadings for which the locomotives are intended.

Premature Engagement of Teeth

Analysis will show that premature engagement is the exciting cause of severe transient accelerations of the rotating masses, while delayed engagement follows less severe angular accelerations which are produced by the driving torque. The accelerations of premature engagement are directly opposed by the torque of the motor and the moment of inertia of the rotating parts on the driving side of the system, and on the driven side are opposed by the moment of inertia of the gear rim, the friction between the gear rim and the gear center, and the driving-torque reaction as applied to the gear rim through the radial leaf springs with their inherent frictional damping. It is apparent that the tendency of all inertias, live forces, and frictions is to increase the severity of the dynamic conditions accompanying premature engagement.

From a paper presented at the annual meeting of the American Society of Mechanical Engineers, New York, November 30 to December 4, 1925.

It would appear that the vibration accompanying premature engagement due to relatively short normal pitch on the driving element is characterized by about the same severity during motoring and regenerating. In actual service, however, with equal discrepancies, the vibration accompanying regeneration is materially more severe than that occurring during motoring. It is therefore necessary to look further for the reason.

With the gears under discussion, the transient peak of normal pressure associated with the impact of premature engagement during regeneration occurs at a point more remote from the pitch point than the corresponding point during motoring. This is due to the long and short-addendum teeth employed. Since the sliding component of the relative motion of mating teeth is a direct function of the distance of the contacting point from the pitch point, it follows that the rate of sliding during the premature engagement of regeneration is greater than that occurring during motoring.

The disturbing turning moment of tooth friction active upon the pinion, and therefore upon the entire rotor, is comparatively small when the pinion drives the gear, but when the gear drives the pinion, with an identical normal pressure cycle, in the particular gearing under discussion it becomes 2.34 times as great. It will be noted that the entire load is assumed to be carried by one tooth, even at the ends of the line of action. In new gearing of the class under discussion, this must be expected, as the precision essential to cause an actual division in line with theoretical perfection is too expensive, if at all possible.

With Brown and Sharpe standard tooth forms, the tooth friction couples discriminate a little less against the regenerating condition, in so far as their maximum value is concerned. Here again we face a compromise between the strength of the pinion teeth and the forces inflicted upon those teeth. The final selection appears to be beyond the possibility of pure analytic determination, and can be based only upon broad experience assisted by tests with the torsiometer or other similar instruments. These variable disturbing frictional couples tend to produce oscillations of the entire rotating and associated structures. This simply means that, through the action of friction, some of the kinetic energy of the armature is transferred to the gear, the armature being negatively accelerated and the gear being positively accelerated.

Effect of Lubrication

With normal lubrication and under the most severe conditions observed, the oscillations outlined never became sufficiently violent to separate the teeth of the gear and pinion. This was proved by the torsiometer records which reveal an absence of the high frequencies which would be involved. With the teeth of the gear and pinion dry and cutting, however, there is a possibility of extremely severe vibrations being produced by the friction couples. Under this condition, there is also the possibility of the occurrence of higher frequencies, due to the alternate seizing and slipping of the contacting surfaces; that is, a chattering slip. This has received confirmation in service as far as the severity of the vibration is concerned, as dry gears have been found where destructive vibration was promptly quieted by feeding heavy lubricant directly into the mesh.

From this analysis, it is obvious that when a large amount of regeneration is required by the service, and particularly when full-load torque is developed while regenerating, the engineer must adopt a shorter normal pitch on the pinion than he would employ if heavy regeneration were not required. The exact best compromise is evidently quite involved, and is again beyond the realm of pure analytic determination. The normal pitches which now appear to give the best all-around results are given later.

A discussion of tip relief in some little detail seems to be unavoidable since the prime reason for the need of tip relief is found in the discrepancies of normal pitch, and also because in setting up a normal-pitch indicator, the radial extent of tip relief must be considered to insure checking the normal pitch at the extreme outer end of the true involute part of the tooth contour.

With the long- and short-addendum teeth employed, there is, as previously explained, more sliding of the teeth at the recess end of the line of motoring action than at the approach end, and therefore the work of friction is greater at this point. The sliding action consists of the sliding of a relatively long portion of the pinion tooth over a small portion of the gear tooth, thus concentrating the wear on the gear. The control of the permanent distortions of the gear during the heat treatment employed on the gearing under discussion, dictates drawing the gear back to a slightly softer condition than is necessary and feasible for the pinion.

Cause of Gouging

Due to the angles at which the teeth approach each other during motoring and regenerating, the tooth surfaces depart further from tangency when regenerating, and this amplifies the gouging tendency. This is more clearly understood when it is realized that without tip relief, the area which is built up by deflection to support the load must be developed on a portion of the tooth contour which lies all on one side of the nominal line of action. Thus, with any combination which permits the slightest premature engagement, the absence of tip relief invites gouging. During sustained regeneration, there is also more tendency gradually to thin the film of lubricant at the critical area of initial contact, due to the sliding characteristic noted. The engineer must therefore consider whether the best overall results will be achieved by adopting the closest available approximation to the involute, trusting that the gears will work out their own correction during service operation, or whether he should approximate those corrections in the manufacture of the gears.

The maximum working pitch-line velocity of the locomotive gearing used for illustration is about 38 ft. per sec. A normal pitch of the driven gear 0.007 in. shorter than that of the driving gear was found to be too far from equality and cause undesirable vibration, particularly during regeneration. Neglecting elastic relief, we find that at the maximum velocity, the time required to travel 0.007 in. is about one sixty-five thousandth of a second. This is not an accurate evaluation of the time involved in completing the adjustment cycle, but it emphasizes the fact that only a very small time element is allowed for the adjustment of the relative angular positions of the driving and driven masses.

It is thoroughly feasible to develop tip relief which will enable the mating teeth to make comparatively smooth initial engagement, whether premature or delayed, and which will provide a cam action to lengthen

out the time element in which angular adjustments must be made for discrepancies of normal pitch. Any tip relief will shorten the line of action and increase the percentage of single tooth action (in the case of a one-two tooth engagement). If carried too far, the ratio may become even less than unity, which means intermittent action. For this reason, tip relief has been strongly opposed by one school of engineering thought.

Experience with heavy traction electric locomotives shows that the gear will run several times as many miles as the pinions. In the early years of the development of this art, pinions failed from wear and also failed from fatigue breakage, with scattering failures from foreign material in the mesh and other causes.

Heat-Treatment Prolongs Pinion Life

The advance in the art of heat-treatment has greatly increased the life of pinions, but fatigue failures are still too frequent, while the retirement of pinions from wear alone has been greatly reduced. Tooth failure from fatigue has been almost unknown with locomotive gears heat-treated by the best modern methods. Further reductions of fatigue tendency are now in sight, but the details are not germane to this discussion.

Experience also shows that in a heavy-trunk-line electrification, any pinion must be expected to travel widely among the locomotives of its class, due to the exigencies of the service. The engineer must therefore realize that he is dealing with a system of gears in a broad installation, and that his problem is much more difficult than that involved with a pair of gears that are mated for life. To launch such a system of gearing under the most favorable circumstances, when, as has usually been true to date, the overwhelming proportion of the service is motoring, and when regenerating, though important, is effective for only a small percentage of the total operating time and with reduced torque, the following standard practices must be established:

The normal pitch of the gear must lie within limits close to the normal pitch of the pinion. It may be slightly greater, and may be less by a considerably larger tolerance.

When regeneration is more important and full-load regenerative torque is developed, it becomes necessary to shorten the normal pitch of the pinion.

The functions determining gear performance are so numerous and so involved that a sure determination of the extreme limits for normal pitch which will draw the line between success and failure, may never be sharply defined. But experience is accumulating rapidly in this recently appreciated phase of the gear art which is establishing certain limits as being safe. The doubtful question is how far the limits may be spread in an attempt to relieve the user of the high cost of precision work. The tips of the teeth should be relieved to reduce the vibration and noise attendant upon working out relief as a by-product of service operation, and to preserve the involute contour at the flanks of the teeth.

The limits to be adopted are necessarily affected by the tendency of the gear and pinion to wear toward or away from equal normal pitch. It is interesting in this connection to note that during the early stages of service in the installation used for illustration, there has been a marked tendency to wear toward equal normal pitch. Therefore the modifications of normal pitch recommended are for the purpose of easing the performance during the breaking-in period.

The first gears and pinions in the installation under discussion were finish-hobbed and then given a drastic heat treatment. During this treatment, the pinions became permanently barreled; that is, the diameter at the mid-width of face was greater than that at the ends.

Four major departures from machined condition appeared in the gears after the heat-treatment:

Varying overall shrinkage. (This also occurred in the pinions, but the diameter was small enough to keep this feature within limits that avoided trouble).

Departure from circle toward an oval and toward more complicated shapes.

Departure from cylinder toward an approximation of a cone.

Departure from plane.

A locomotive was assembled in line with previously acceptable practice, with run-of-production gears, and was put into service after a brief test. The result was unsatisfactory.

A second locomotive was assembled with the gears and pinions matched as regards overall shrinkage, and assembled to compensate as far as possible for distortions. The preliminary performance showed a material improvement, and this locomotive was also put into service and the gear performance was quite satisfactory.

At this stage of the development, there was grave doubt as to what constituted the real "measuring stick" for the predetermination of performance. There was, therefore, insufficient assurance of being able to duplicate the action of the matched gears. Arrangements were therefore rushed to grind the contour of the teeth of the remaining gears and pinions. The first ground pinions were produced with facilities that proved inadequate, and their performance was, if anything, worse than that of the unground and unmatched pinions. The first ground gears were produced on a reconstructed gear-cutting machine. All of this grinding was done with a formed wheel, and in the early stages the wheel-trimming devices were far from ideal.

Uniformity of Pitch Essential

After considerable study, it was decided to base the selection of gears and pinions upon the uniformity of chordal pitch. To be more explicit, a gear was to be tentatively considered good if its chordal pitch was fairly uniform. This chordal pitch might vary slightly from that of the pinion with which the gear was to mate, without condemning the gear or the pinion. The reason for this basis of selection was that the unsatisfactory performances noted were always characterized by some cycle of vibration and noise, which was in phase with the revolutions of the gear. This cycle had decided individuality in many of the gears, and there seemed to be a reasonable expectation that a gear of good uniformity would reduce this cycle within acceptable limits.

After gears sufficient for equipping two or three locomotives were ground, a chordal-pitch indicator was developed. This indicator has hardened registering points which align it relative to the side and to the ground bore of the rim. A hardened pin contacts with a tooth at the pitch line, and a dial indicator with the usual bell-crank attachment, contacts with the adjacent tooth at the pitch line. For purposes of record, in inspecting these gears the start was always made on a witnessed tooth. With the instrument in clockwise recording position on the first tooth, the dial was set at

zero. With the contact pin in the same space, the indicator was swung to the other hand and the counterclockwise calibrating setting at zero adjusted on the second dial indicator. The indicator was then entered on the next tooth and the readings were recorded as No. 1. All teeth were measured and recorded successively, the hundredth readings being taken on the tooth of original dial adjustments, which must therefore read zero and check that the calibration of the indicators had not been altered. The readings were then plotted and the datum line corrected to read the average.

All the gears that had been ground up to this time were plotted, and it was found that the best that could be expected from the facilities then available was a variation from average chordal pitch of ±0.004 in. This value was therefore adopted as the limit for the locomotives involved. Every tooth that exceeded this limit was retrimmed on the machine and brought within the limit. In the meantime, another gear-grinding machine was being brought through by the Newark Gear Cutting Machine Co. As soon as this machine was installed, it was tried out, and it was found practicable to cut the limit of departure from average chordal pitch to ±0.002 in. A trimming device, also, was made by the same company, which gave much better contours.

The third locomotive was equipped with gears and pinions within this limit. The preliminary trials of this locomotive showed that the gearing was still unsatisfactory.

These events led to the analysis outlined in this paper, which shows the importance of a proper relation of the normal pitch of the gear and the pinion.

Normal-Pitch Indicator

Another normal-pitch indicator was then developed. This outfit included segments of the base circle bolted to the gear in proper concentric relation, and a tangent frame. This frame determined the location, upon the common normal of adjacent teeth, of a dial indicator finger at the outer end of the involute contour of one tooth, and of a locating plug on the adjacent tooth. The dial was set to a calibrating plug gage to read zero at the exact calculated normal pitch. This indicator therefore read the actual normal pitch instead of a relative value as in the chordal-pitch indicator. This indicator could be applied only at lateral locations about an inch away from the edge of the gear.

It was useful, however, in the practical development of the fact that variations of plus or minus a sixteenth of an inch in the radius of the base circle produced errors so small as to be within the accuracy of reading of the indicator. As this variation more than covered the range of permanent shrinkage of the gears during heat-treatment, it was at once evident that a very convenient instrument could be made that would read at any point across the face of the gear. This instrument could register on either the tips of the teeth or the bottoms of the tooth spaces, or the registering parts could bottom on the flanks of two adjacent teeth. A hardened and ground cylindrical member bottoms on the flanks at a depth which brings its contact on that common normal to two tooth contours which passes through the outer end of the involute part of the contour of one of the two teeth, at which point an indicator finger is arranged to make contact. The alignment of this common normal is determined, within the required accuracy, by the locating leg remote from the indicator and registering in the bottom of a tooth space. The length of the contact cylinder is sufficient to insure a firm square setting of the indicator.

The check-up on the range of normal pitch of the gears showed that they ran quite uniform, the variation being about 0.004 in. The pinions also were quite uniform, the variation being about 0.002 in., but the actual value of their normal pitch was about 0.007 in. longer than that of the gears, and this was the principal reason, from the gear standpoint, for the unsatisfactory operation. While the motoring operation was better than it would have been had the normal pitch of the pinions been shorter than that of the gears by the same amount, it was too far from equality. A set of pinions was produced with a normal pitch 0.002 in. shorter than the gears, and while this discrepancy was still on the less desirable side of equality for the motoring condition, it proved to be about the best compromise for the overall service of motoring and regenerating, and corrected the difficulty that had been experienced.

A considerable range of installations using gears and pinions as they clean up in grinding out heat-treatment distortions, is under way and is developing in some measure the limits of discrepancy of normal pitch within which acceptable operation can be achieved with the particular gearing and service under discussion. The gears giving the best performance are rated 100 per cent. The lowest passing grade is 95 per cent.

This method of rating is open to some criticism as it is not possible for the observer to calibrate himself with complete accuracy. Continual care is required on the part of the observer to distinguish between noise and vibration, as it seems to be pretty thoroughly established that they do not bear a constant relation. Vibration is therefore the major consideration in rating the performance.

Errors of Mounting

No detailed reference has been made of the errors of mounting that were found to exist, as simplicity was served by confining attention to the gear teeth. Concurrently with the investigations of pitch, the entire mounting was overhauled and checked for accuracy, and the existing errors reduced as far as practicable. The overall investigation proved conclusively that acceptable operation could be secured only when the discrepancies of both the mounting and the gears were held within proper limits in their salient characteristics.

The conclusions for locomotive motoring and regenerating service are:

The normal pitch of the driving and driven gears must lie within limits determined on the basis which has been set forth.

The tips of the teeth should be relieved on the basis outlined. This is more vital on the pinion than on the gear.

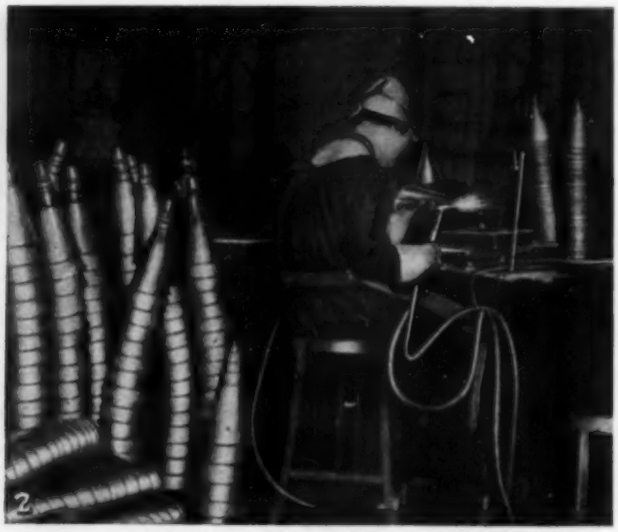
Acceptable gear operation can be secured in locomotive installations where back-driving is essential.

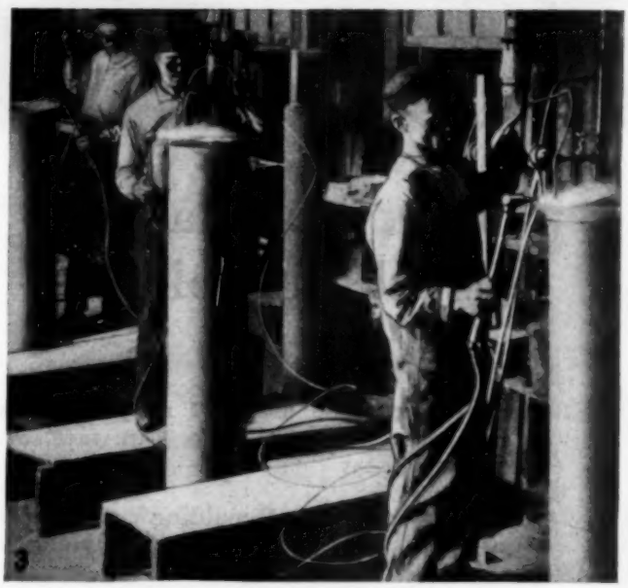
The degree of quietness of gear operation can be fairly well predetermined by checking the known salient characteristics of the gears and mounting.

Selection can be made between gears that require grinding and those that may successfully be put into service as they come from heat-treatment.

An adequate supply of proper lubricant must be present on the teeth during the entire working cycle of the locomotive.

Data must be accumulated for a considerable period to determine the widest limits that may be adopted for the salient variables in order to make costs as reasonable as possible.





Oxyacetylene Welding in Production Work

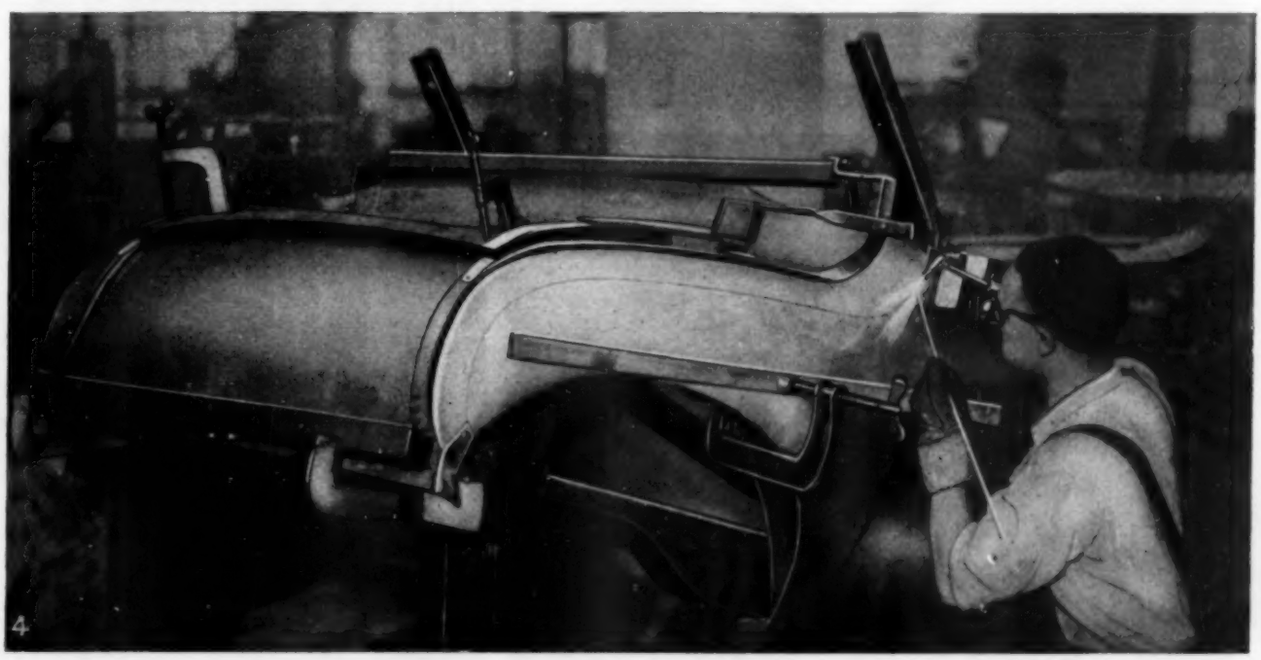
1—Welding spouts and handles on teapots

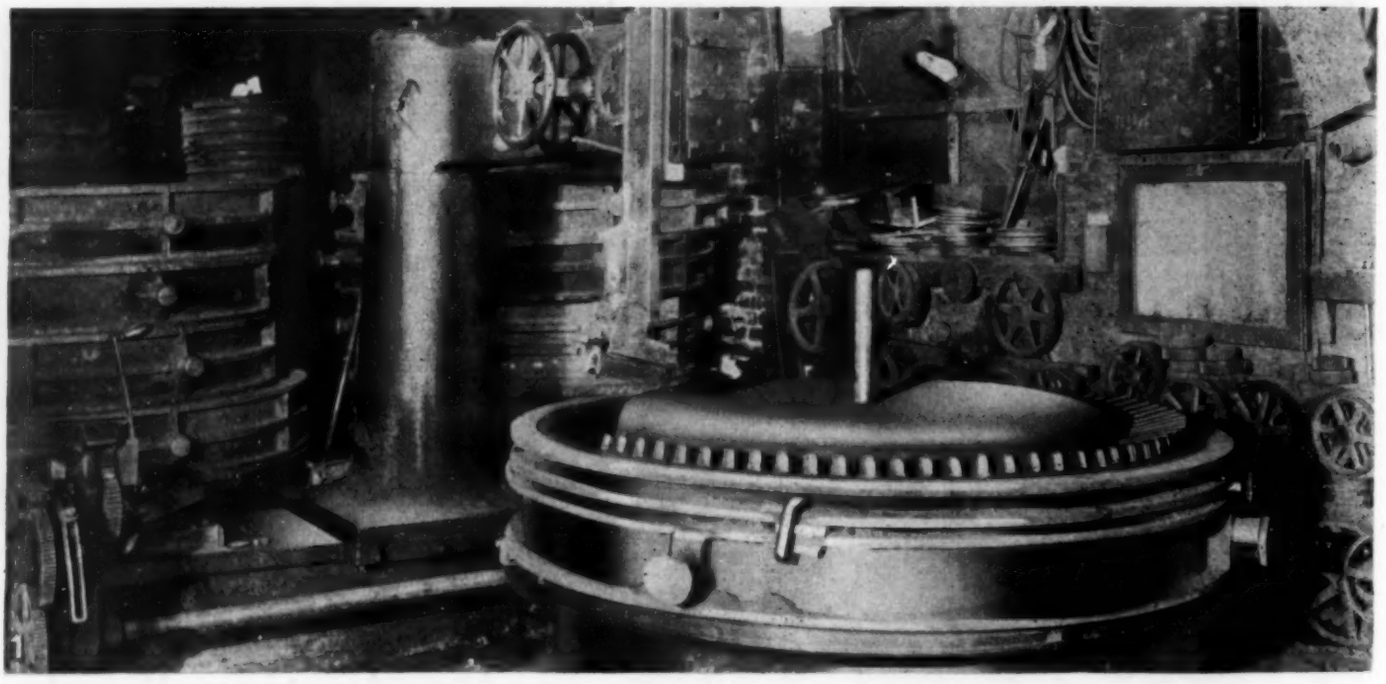
2—Mufflers for automobiles are welded in large quantities

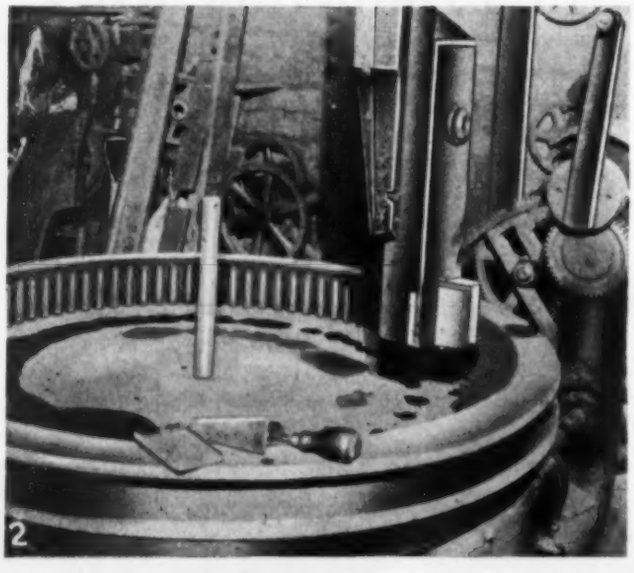
3—Bronze-welding malleable iron heads in household boilers

4—Jig-welding aluminum automobile bodies

Photographs by courtesy of the Oxweld Co., New York





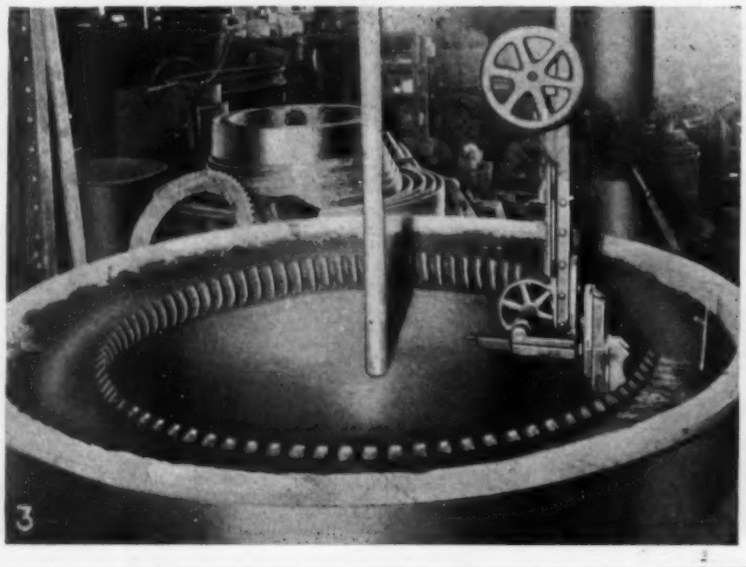


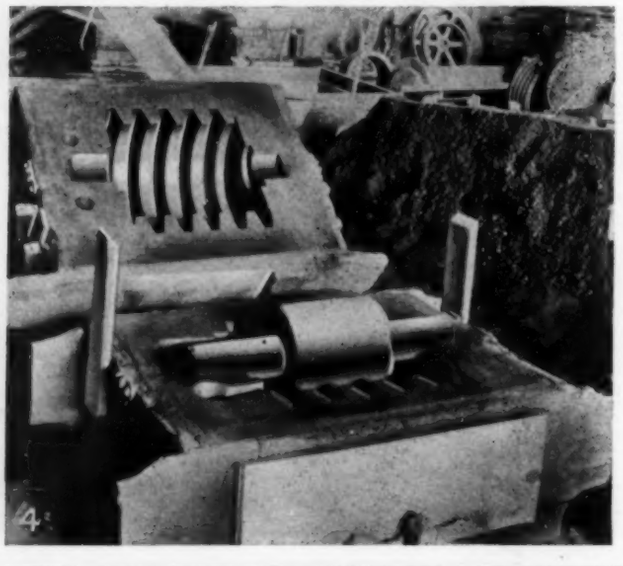
Method of Making Machine-Molded Gears

1—Indexing machine used for molding teeth individually for a 2½-pitch, 7-in. face, 84-tooth bevel gear

2—Close-up view of small molding machine for spur gears. Each tooth is individually molded

Photographs by courtesy of the H. W. Caldwell & Son Co., Chicago





3—Making the mold for a 2¾-pitch, 6¼-in. face, 92-tooth wormwheel

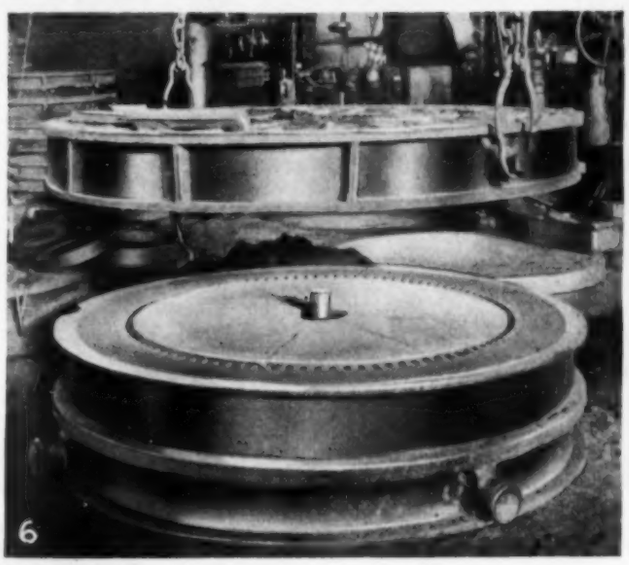
4—Completed mold for a 3½-pitch, 17-in. diameter worm

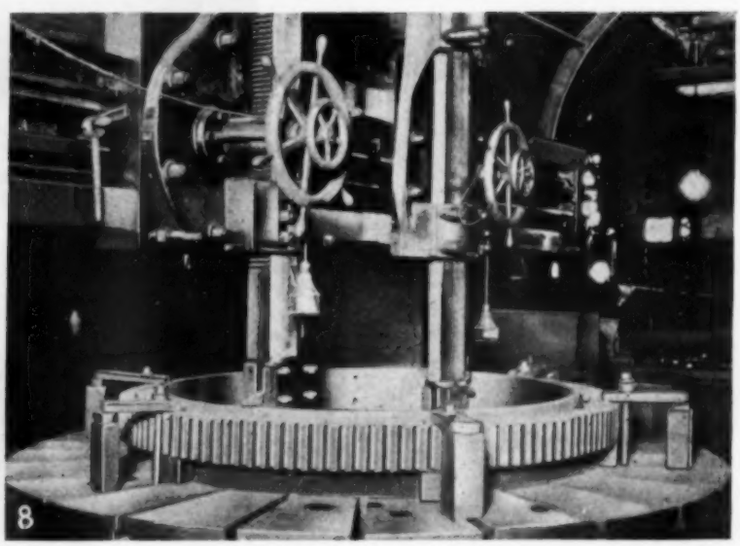
5—General view of the foundry showing a variety of work in process

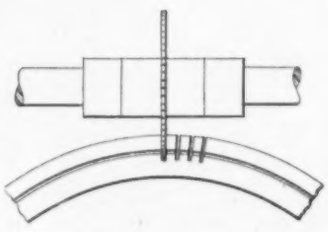
6—A dry-sand mold for a 1¾-pitch, 5½-in. face, 104-tooth spur gear being assembled

7—The cope and drag for a 2½-pitch, 7½-in. face, 60-tooth spur gear.

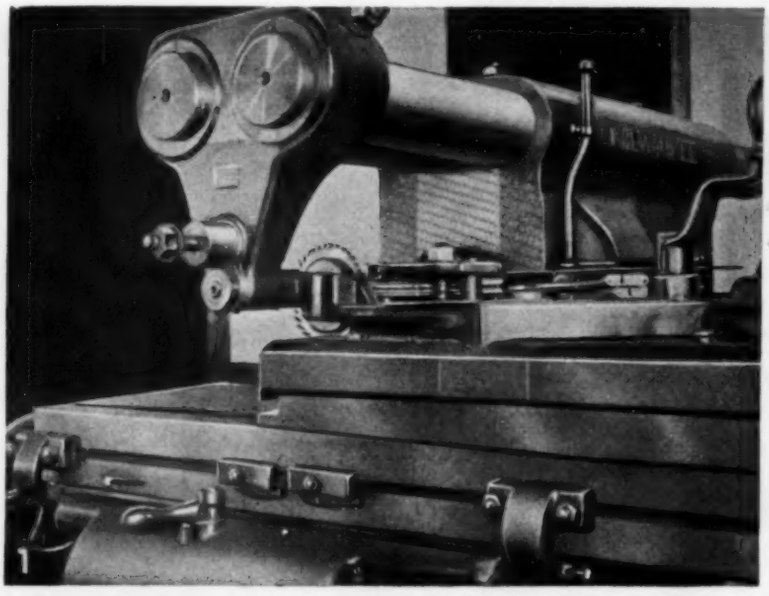
8—One of the larger sizes of spur gears set up on a boring mill for machining. The teeth do not require finishing







Diagrammatic plan view of setup shown in Fig. 1



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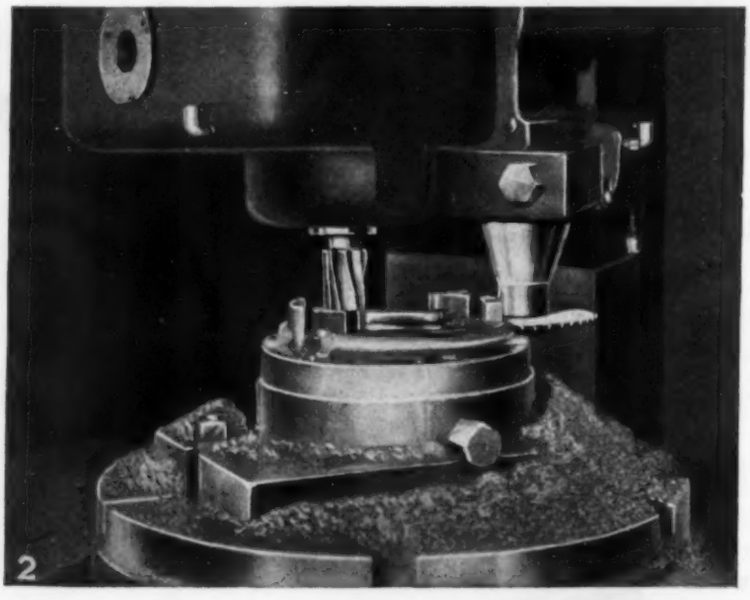


2

Milling Machine Setups on Typewriter Parts

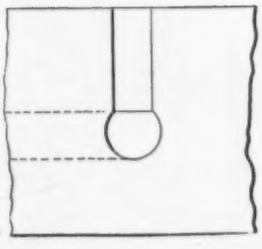
Fig. 1—Automatic indexing fixture for slotting

Fig. 2—Simultaneous milling and slotting

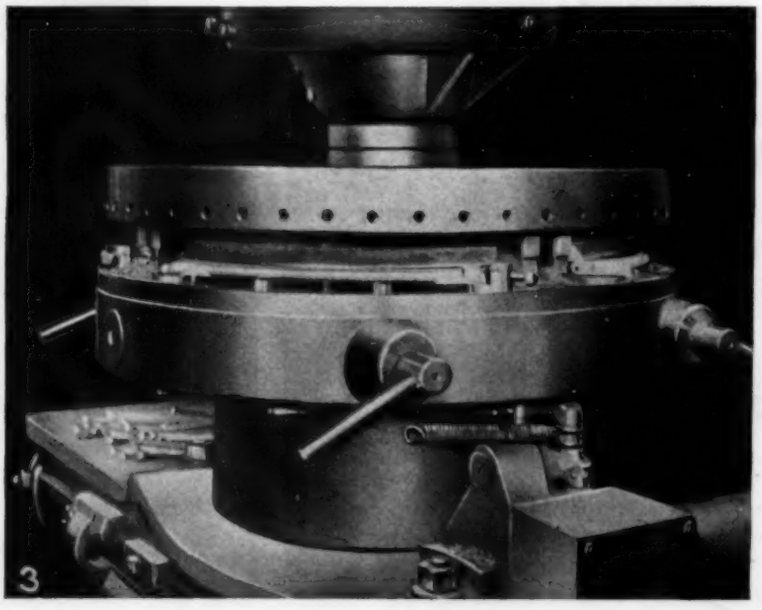
Fig. 3—Undercutting a circular slot

The three operations are performed on Milwaukee milling machines

Photographs by courtesy of the Corona Typewriter Co.



Diagrammatic elevation of circular form made in the slot on the setup shown in Fig. 3. There are two cutters in pairs, one to rough and one to finish



3

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Fan for a Heat-Treating Room

BY CHESTER H. FRANKLIN

In spite of ventilating windows, there are times when a breeze from a fan helps out in making a heat-treating room comfortable. The method of utilizing a motor-driven fan shown herewith is from the heat-treating room of the Kelly Press division of the American Type Founders Co., Elizabeth, N. J. The fan, as shown in Fig. 1, is about 24 in. in diameter and is driven by belt from the small motor beneath.

Special mountings are used so that the fan can be swung to any desired angle and the breeze directed to any part of the room, as required. The fan has proved

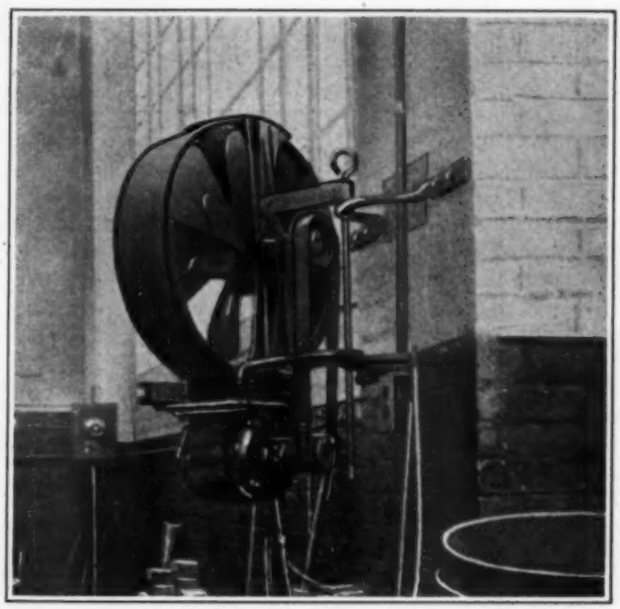
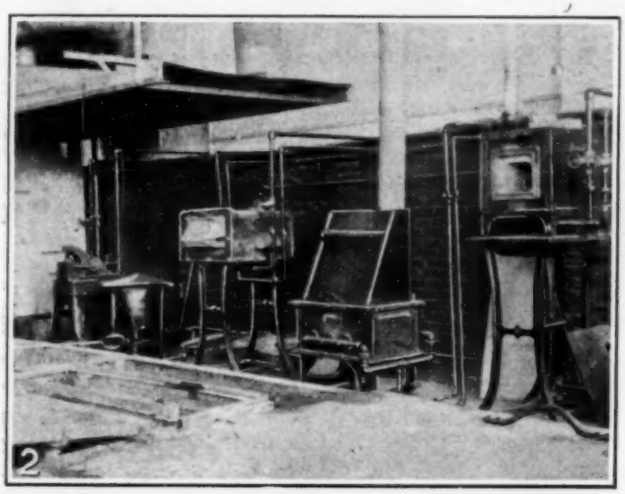
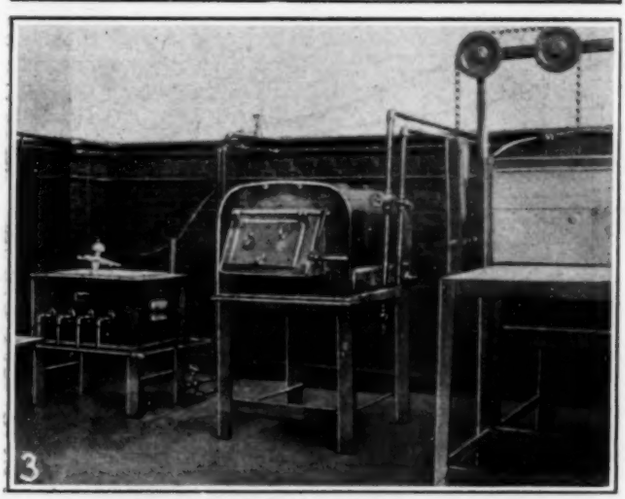


Fig. 1—Adjustable ventilating fan

a great convenience on days that are trying to patience, and indirectly, on the quality of work.

Two other views of the hardening room are shown in Figs. 2 and 3. These views show the variety of heating equipment for work of different kinds and the conveniences provided.





Figs. 2 and 3—Different heating equipment to suit various work

Cutting Cost on a Round Corebox

BY DONALD A. HAMPSON

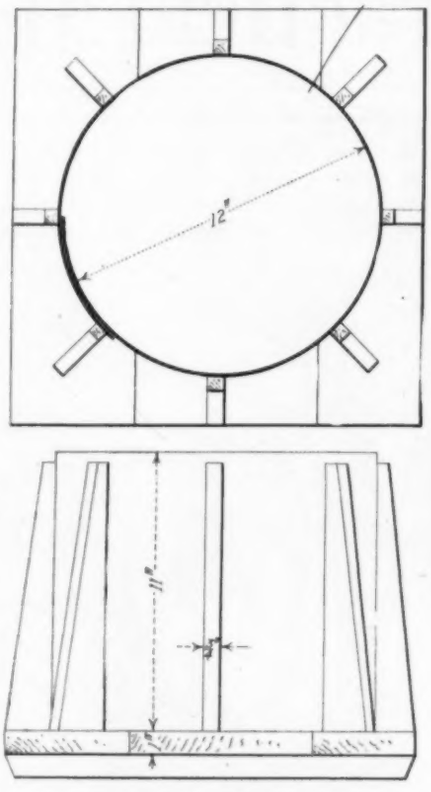
Coreboxes other than rectangular are slow to make and proportionately expensive. The amount of building up that is necessary to the preparation of a blank from which the desired curves may be shaped is usually the slowest part of the job and, in the case at hand, it was avoided by combining wood construction with metal.

A core 12 in. in diameter by 22 in. long was required for an iron cylinder, of which there would be but two or three castings needed per year. To have the opening round and to size was quite important. Consultation with the foundry foreman brought out the information that he would prefer, next to one large complete core, a core made from two sections, each section to be half the stated length.

To make this corebox 12 in. diameter and 11 in. deep at low cost was the pattern shop order. Several castings have been made from the equipment built,

IDEAS FROM PRACTICAL MEN

and, as the box was cheap and the cores were satisfactory, a drawing of the box is given herewith. A bottom board was made 18 in. square and battened to prevent warping. On it was drawn a circle of proper diameter to serve as a guide in placing eight upright pieces of wood, which were screwed to the face. These pieces were carefully cut so that their important faces were at right angles to the bottom board when they were fastened in position.



A cheap circular corebox

The purpose of the uprights was to hold a strip of 0.020-in. gage sheet metal, bent into a cylinder. The strip was long enough to overlap ¼ in. and thus avoid the slight departure from circular form that would occur if the ends were butted. One brad at the top and one at the bottom of each upright brace served to keep the lining in shape.

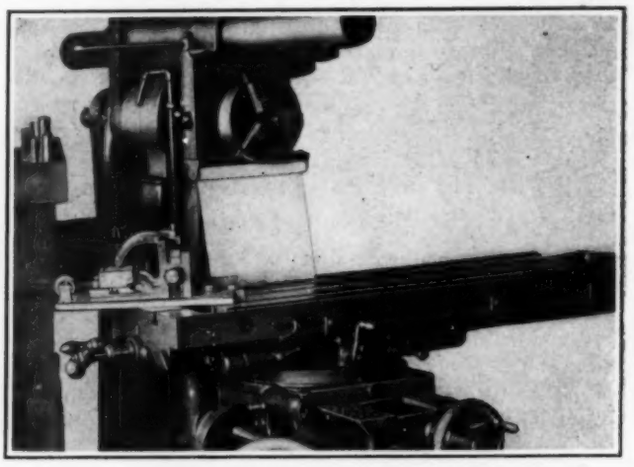
Device to Keep Chips from Sliding Surfaces of Milling Machines

BY W. F. SCHAPHORST

The accompanying illustration shows a simple, yet very efficient, device used by the R. G. Smith Tool & Manufacturing Co. of Newark, N. J., to keep chips and dirt from the cross and vertical sliding surfaces of milling machines, regardless of the position of the work. I have observed it in every-day work and know that it is a good thing. It is made by using a roll of tough oil cloth mounted on a shaft as shown, the free end of the cloth being attached to the base of the cross slide.

The device is applicable to milling machines of any width or height by simply making the roll long enough and wide enough. The roll is fastened into a framework made of sheet metal. The framework has a flat, protected top to keep the roller from becoming injured in any way and also to give the device the needed strength. The framework is fastened to the vertical slide as shown. It is so made that it can be raised or lowered, and is held in any position by a brass clamping screw at one end of the frame. The screw is not visible in the illustration as it is on the far end of the frame. A brass screw is used in preference to any other kind so that the vertical slide will not be injured.

The lower, or free, end of the cloth is attached to the base of the cross-slide so that as the slide is moved in or out, the cloth is always in the proper position to



Device to keep chips off the slides of a milling machine

catch chips or dirt. A coil spring on the shaft within the roller is so arranged that it holds the cloth taut at all times regardless of the position of the slide.

The device saves much time that would otherwise have to be devoted to cleaning, and at the same time it benefits the machine.

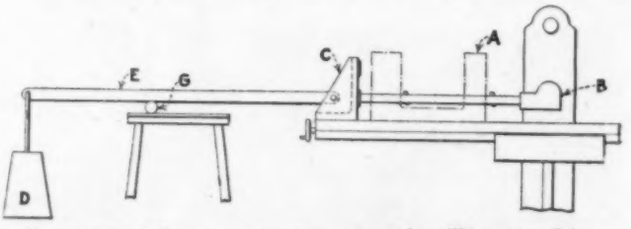
Boring on a Milling Machine

BY BEN J. STERN

In a small shop where I was at one time employed, the boss took a contract to make some pumps, the main castings of which presented a problem in boring, since we had no boring machine.

We finally rigged up our milling machine for the job, placing the castings at one end of the table as shown in dotted lines at *A* in the illustration. We used the rack-cutting attachment *B* to drive the boring bar, the outbroad end of which was supported by a bushing in the angle plate *C*.

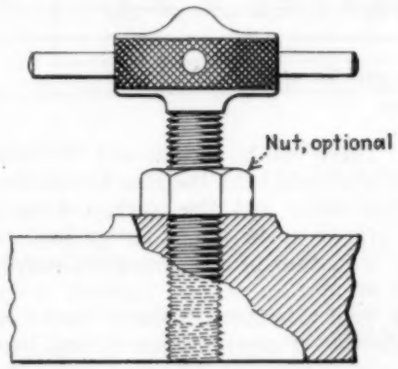
After we had made our set-up, we found that the combined weight of the casting and the angle plate, bound the table so badly that when we put on the feed



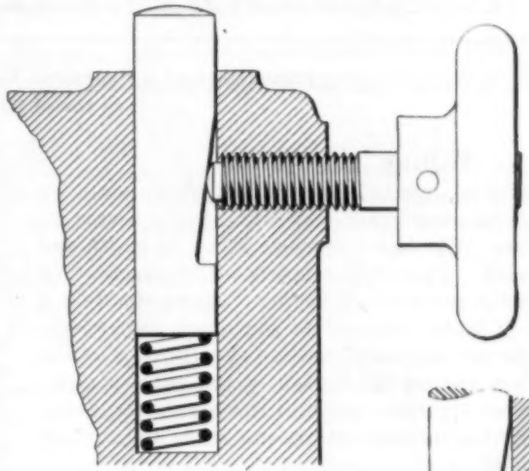
Counterweight to overcome sag of milling-machine table

the universal-joint pin sheared. To eliminate the trouble, we hung the counterweight *D* on the bar *E*, attached by one end to the angle plate and fulcrumed on the roller *G*. While the travel of the table changed the leverage, the change was not great enough to materially affect the power required to move the table.

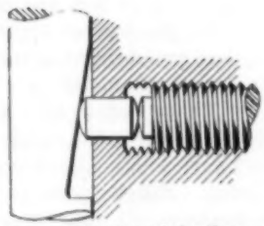
Design of Jacks for Jigs and Fixtures



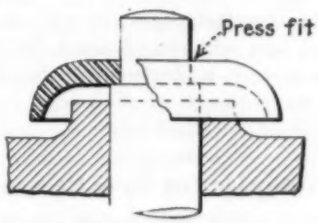
Common Form of Screw Jack



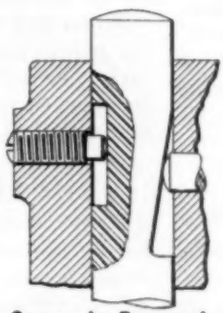
Simple Form of Spring Jack



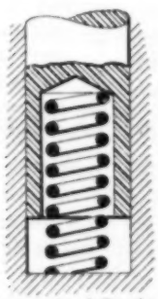
Lock Pin Used to Prevent Screw Head From Spreading



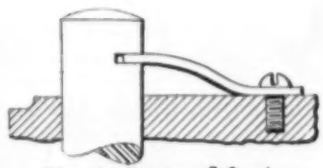
Dust Cap for Plunger



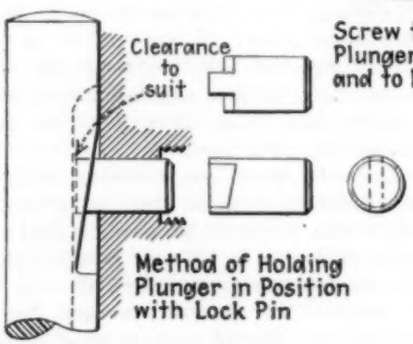
Screw to Prevent Plunger from Turning and to Limit its Travel



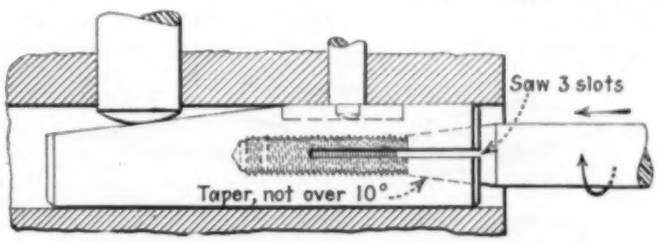
Inserted Spring



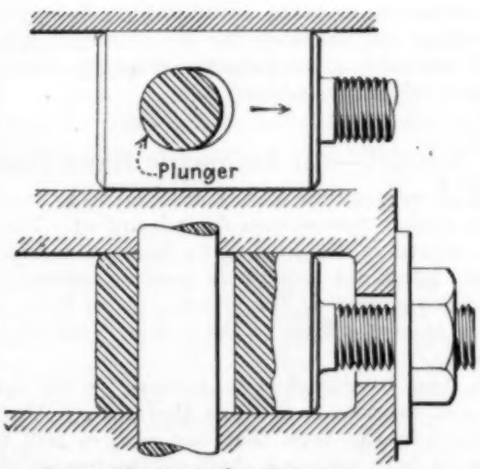
Simple Form of Spring



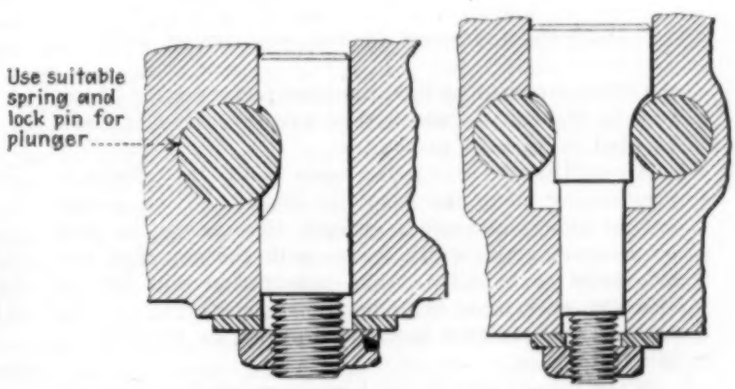
Method of Holding Plunger in Position with Lock Pin



Push-Type Jack. To Operate, Push Plunger in and Turn Screw to Lock in Place



Draw-Pin Lock for Plunger



Wedge-Type Jack — Single and Double

Punch here to suit your binder

Dec. 10, 1925
© American Machinist

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Milling Aluminum

Q. We have a quantity of No.-12 aluminum-alloy bases to machine on a number of 4-in. square bosses on the top surface. The bases measure 15 in. in width and 27 in. in length. The alloy consists of 92 per cent of aluminum and 8 per cent of copper. Approximately ⅛ in. of metal is to be removed in the machining operation. Perhaps you have information in your files on the methods to use and on the design of the cutting tools.

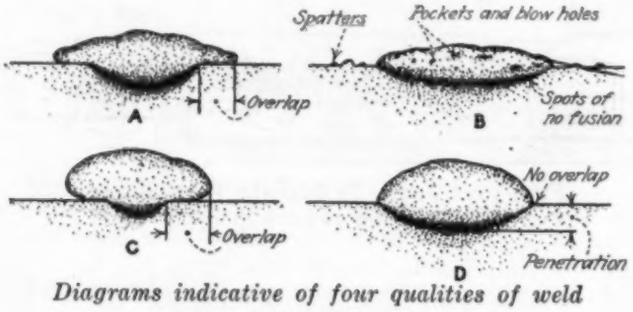
A. We believe that you can mill the bosses to advantage providing the milling cutters are made for cutting the given metal.

There should be a negative rake angle of about 6 deg. to prevent the blades from digging into the work. There should be a clearance angle of approximately 3 deg. Finally a shear angle is required that can be held between 10 and 15 deg., measured from a line parallel to the axis of the cutter bore.

Visual Inspection of an Arc-Welded Seam

Q. Is it possible to tell what can be expected of an arc-welded joint by a visual examination of the weld? We do not expect to count on such an examination as an absolute index, but do hope to use it as an indication of the quality of the work.

A. The question you have asked requires a good deal more of space for a complete answer than can be given on this page. We suggest, therefore, that you get in touch direct with the makers of your equipment and



Diagrams indicative of four qualities of weld

the other arc-welding machine manufacturers for literature on the subject which they have prepared and will be glad to furnish to you.

A weld that has been made with the electrode progressing along the seam too slowly will be spread out an abnormal amount on each side, as can be seen by comparing the width across with the gap that was originally to be filled. The penetration will not be effective over more than an approximate half of the width, the remainder being overlapped, as at *A* in the illustration.

When an arc that is too long is maintained to make the weld, there will be spatters of metal, beyond the welded portion, adhering to the surface of the welded parts. There will be pockets and blow holes on the surface of the weld. At the line of division between the deposited metal and the work, not visible of course, there will be spots where fusion has not taken place due to oxidation of the deposited metal and to other causes, as at *B*.

In a weld attempted without regulating the current to produce a sufficient amount of heat, there will usually result a high ridge of deposited metal that will show a rounded underturning edge where the metal solidified before it could flatten down on the work and take hold. Penetration will be very poor. This is shown at *C* in the illustration.

When the weld is satisfactory, it will show none of the points named and will round down to the work on each side without any underturning tendency. The penetration will start almost at each edge of the deposited metal, as at *D* in the illustration.

Old Principles for New Purposes

Q. We have designed a new automatic machine and have it in operation. The machine involves no new principles but the application of old principles is, we believe, entirely new. Can we obtain protection through patent or copyright?

A. It is possible and practical for you to secure patents on old principles which are applied in new combinations to new uses, as well as on new principles applied for the first time.

We desire to warn you, however, against approaching the problem without due investigation of those through whom you may propose to deal. We suggest, therefore, that you go to your own lawyers or request them to make recommendations, if they cannot themselves institute the necessary search for prior claims, as to whom you should present your data.

The process involves the search for possible applications that cover the point prior to your own beginnings and then the drawing up of claims, making the patent drawings and applying for the patents. All of this is best done by a competent dependable lawyer who is versed in the procedure.

Wanted—An Automatic Hand Hammer

Q. Kindly advise where to locate the manufacturer of a certain hammer we have heard of. The handle is hollow and is designed to be filled with small tacks or brads which are brought to position automatically. All that is required of the operator is to force the handle down to give a blow to the tack or brad that will send it home.

A. Our records show no hammer on the market such as you describe. We are therefore publishing your inquiry in the hope that our readers will be able to help us both out, and shall advise you as soon as we hear from them.

Technical Abstracts

Material Handling

According to H. J. Forsythe, president and general manager of the Hyatt Roller Bearing Co., it is the aim of present-day production to route the work through the most efficient sequence of operations with the minimum manufacturing delays, and also to decrease human fatigue by improving handling conditions with a resulting increase in the efficiency of labor. The following factors must be considered in arranging a plant; building arrangement and type of structure, number and location of separate manufacturng departments, multiplicity of operations within each department, nature of the product, with its variety of sizes of product and details of the factory cost system.

It is obviously much simpler to handle parts of a product made in one type and three sizes than it is to handle a product made in three types and 300 sizes. This is particularly true with a shop on a piece work system where all incoming and outgoing material must be maintained in separate containers, separately checked, in order that individual output may be accurately determined without confusion.

A modern manufacturing structure centers around a plant arrangement of machinery, designed to take full advantage of the possibilities of automatic conveying systems to eliminate trucking, handling and labor fatigue. What is ultimately desired is the transportation of material at the lowest cost. We must not supplant one system with another system unless the labor saving effected by the change warrants it. In the Hyatt plant, in one case, it is found practical to use a truck of approximately the same height as the machine base. This truck acts as a carrier or tote box for the work and is merely drawn from one operation to another, thus allowing continuous segregation of parts handled and accurate cost control without mixing sizes.

The collection of rubbish through the plant was formerly made by two men and an electric dump truck but now three long vertical chutes running down from a central location to the outside of the buildings is used and rubbish is dumped into the chutes and is discharged into large trailers on the ground level, a tractor removes these trailers at intervals to a place where the combustible material is burned.—*Management and Administration*, Sept. 1925, p. 137.

System of Fits

C. D. Albert, professor of machine design, Cornell University, discusses a system of limits for different kinds of fits and states that, assuming reasonable tolerances and allowances known, a comprehensive system of fits for a desired range of nominal sizes cannot be fully set forth until it is decided whether the system is to be based on the hole or on the shaft. If the hole is taken as the basis, the diameter of the shaft is varied to secure the allowance and kind of fit desired. If the shaft is taken as the basis, the diameter of the hole is varied to secure the allowance and kind of fit desired.

Where the holes to be made are all small, say, not over 3 in. in diameter, the hole as a basis has a decided advantage over the shaft as a basis. This is true where the holes are small since they can be reamed to size. For any given grade of work only one reamer for each nominal size would be needed for all kinds of fits instead of a reamer for each kind of fit for any given nominal size, as would be the case were the shaft the basis. Since mass-production methods are usually applied to small machines having small parts, this advantage of the hole as a basis may be considerable. Similarly, the hole has a decided advantage over the shaft as a basis with respect to the number of mandrels required.

A system based on the hole breaks down, however, where there is more than one kind of fit on the same shaft or spindle, but this may not mean that the hole as a basis should be discarded. If for the manufactured product, two or more different kinds of fits on the same shaft occur only infrequently, it might easily pay to retain for general use throughout the plant a system based on the hole and to create special holes where more than one fit is required on the same shaft.

Where the holes are so large that reamers would not be used, or where conditions are such as not to warwant an investment in reamers for even the majority of holes that could be reamed, the shaft is a better basis for a system than the hole. The shaft as a basis does not break down and has no exceptions in application. In this respect it is superior to the hole as a basis.—*Mechanical Engineering*, Nov., 1925, p. 901.

Machine Tool Safety

R. F. Thalner, safety director, Buick Motor Co., points out that in the automotive industry, effort focused on preventive measures looking toward the elimination or reduction of casualties and fatalities has resulted in greatly increased conservation of life and property. It is evident that new methods, new means and new modifications must be continually in process and that putting these forces into production requires concentrated scientific study, forethought and executive ability.

The author not only outlines previous and present practice but states the governing factors of accident-prevention progress and suggests possibilities of improvement of methods and the means for applying them, referring specifically to machine tools. Forethought exercised in the design of tools to make them safe as well as suited to the work is the best method, and redesign is practiced when hazards become apparent after a tool is put into operation. If redesigning a tool does not make it safe to operate, the next best method is to guard it. Emphasis is centered on the statements that most accidents are caused, they do not simply "happen," and that tools which cause accidents can be made safe.—*S. A. E. Journal*, Nov., 1925, p. 479.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

What Aviation Needs

AVIATION needs a chance to develop rather than a subsidy to nurse it along. It needs regulation to prevent irresponsible pilots from carrying passengers in obsolete planes.

The airplane industry needs to be freed from the competition of government stations in the design, construction and repair of planes and apparatus, at least until the industry has secured a market in commercial lines. For unless the industry can be maintained on an efficient, even if skeleton, basis, we should be without adequate sources of supply in any emergency.

The extracts from the report of a committee of the Department of Commerce and of the American Engineering Council in another column, are of special interest as they point out what is necessary for the development of aviation in this country.

Technical Books and Magazines

ON WHICH shall the engineer or manufacturing executive depend for information, the technical book or the technical magazine? Some men depend on one source, others on the other one, but actually no one can really be sure that he is taking advantage of every opportunity unless he has both. The two sources of technical information are in no sense antagonistic but rather supplementary to each other.

One of the leading public librarians of this country has adopted the practice of keeping extra copies of certain technical magazines on hand for loan on the regular library cards. In his notice regarding this system he quotes a statement to the effect that technical books are out of date as soon as they are published. The statement might be true if the reader of technical books depended on them for the last word in modern methods, but he would be foolish to do so. Fundamental principles of an art, a science, or an industry change but slowly and it is these facts for which the seeker must turn to the technical book. His last-minute news of new applications of the principles he must get from the technical magazine.

On the other hand, the reader who expected to get fundamental principles from the magazine would be equally disappointed. In the field of the "American Machinist," for instance, progress is so rapid that it is difficult to keep up with it in the space available and utterly impossible to republish basic facts as well. For these a man must refer to his technical library. The more complete his library, the less chance he takes of a possible error of judgment because of insufficient information. And in these busy times it does not pay to take such chances.

Secretary Hoover Reports

THE Secretary of Commerce is entirely justified in "pointing with pride" at the results of his campaign to eliminate waste in industry. His annual report, just made public, really claims much less credit for the results of the campaign than is deserved. It is true, as he says, that the Department of Commerce has only helped to organize a movement that has met with enthusiastic public support almost everywhere. Nevertheless, the movement might well have got off the track or expended itself in futile resolutions and idle oratory without the astute guidance it has had.

Of particular interest in Mr. Hoover's report are the facts quoted to show relative wage and commodity price trends. Wages are higher now than they were in 1920 while commodity prices are lower. Translated into percentages the figures show that wages in 1924, the period covered by the report, were 128 per cent above pre-war while wholesale commodity prices had dropped to 50 per cent above pre-war. Perhaps this will carry more meaning if compared with the 1920 figures when wages were 99 per cent above pre-war while wholesale prices stood at 126 per cent above. The gain in real wages is obvious.

The whole waste elimination program is covered in other parts of the report, each department head presenting the figures for his own department. It may be well to quote some of the advances made during 1924. Among them are: greater efficiency of the railroads; a 60 per cent increase in electric generating capacity; wider provision and use of business statistics as a stabilizing influence to reduce commodity speculation; expansion of industrial research; extension of the building season in the construction industry; and, finally, the saving of millions through simplified practice.

Most of us can remember without undue effort when the Department of Commerce was completely eclipsed by older and larger departments—when it was considered as not much more than a government bureau for collecting a few unimportant figures. That time has passed and the department today is a power to be respected, one of the few government agencies that can show returns to citizens many times the amount spent in carrying on its work. Secretary Hoover and his hardworking assistants are to be congratulated on their achievement.

Shop Equipment News

Unishear Co. Improved "Unishear"

The Unishear Co., 170 Fifth Ave., New York, N. Y., has developed the improved machine, illustrated in Fig. 1, to supercede the original design previously described on page 372, Vol. 63 of the *American Machinist.*

The improved design consists of a cast-iron base machined to carry a ½-hp. General Electric driving motor and a separate housing on which the cutter head is mounted. The machine will produce a continuous clean cut due to the oscillating movement of the cutters, in sheet iron up to 14-gage in thickness and will follow an outline that is straight, circular or irregular in any direction. In 16-gage metal the average speed capacity is 15 ft. per minute. It is also suitable for work in other metals and non-metallic materials. A slight pressure toward the throat of the shear is sufficient assistance to the inherent feeding action of the jaws to carry the work along. The cut can, however, be stopped instantly upon relieving this pressure. The action is smooth and continuous due to the high speed of the cutter and its relatively short travel.

The motor is of the totally inclosed type so that no projections on the

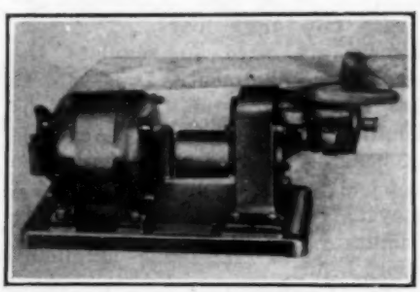


Fig. 1—Unishear Co. Improved "Unishear"

work or no cuttings can get into the windings. It is provided with ten feet of flexible cable containing a conveniently located cable switch and a plug for connection to the source of current. The machine is carried in stock for all of the usual current characteristics and can be furnished to specification for any unusual conditions.

The motor connects to the reduction gearing in the housing through a flexible coupling. The gearing furnishes the proper reduction from the motor speed that depends on current characteristics, so that the shear

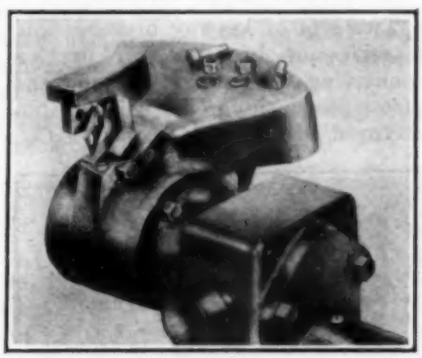


Fig. 2—A detail view of the cutter head

will operate as standard at 1,250 r.p.m. The gears are of heat-treated steel. They run in grease and are supported on ball bearings. Access can be had to them by removing the shear-end cover plate.

A close-up view is shown of the shear head in Fig. 2 to illustrate the setting of the knives and the method used to shim out the blades for cutting very thin materials such as paper which require much less clearance than does a piece of 14-gage steel or copper. The general construction of the head and the clearance curves for cutting to small radii can also be seen to advantage. The design of this head allows the machine to cut corrugated sheets with little flattening of the corrugations and permits of finishing the ends of pipe to irregular outlines after it has been rolled to shape and riveted or otherwise secured.

For cutting large sheets that would ordinarily require more than one man to handle it is recommended that the machine be mounted so its throat is on a level with the bench top. This allows the bench to be used for supporting the ends of the work and makes the work suitable for one-man operation.

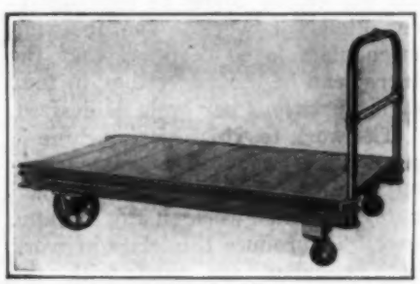
The machine is furnished complete and ready to plug in to the source of current. It measures approximately 8 in. across, 20 in. in length and 10 in. high. The shear weighs 45 lb. including the motor.

Lyon Live Skid Platform

The skid platform, illustrated, is manufactured by the Lyon Iron Works, Inc., Greene, N. Y., for use in connection with electric lift trucks. The platform is made of 2-in. hardwood and protected on the sides by heavy angle irons fastened to the platform by means of plow bolts having heads flush with the angles and the angles flush with the boards.

Two steel channels on each side form the frame work. They are riveted to heavy angle irons to tie them together. The rear wheels are 10 in. in diameter and those in front measure 5 in. They are of the swivel caster pattern. All the wheels are equipped with Hyatt roller bearings and "Dot" high-pressure lubricating fittings.

Four stake pockets are provided, two on each end. A pipe rack having a special ticket pocket is also part



Lyon Live Skid Platform

of the equipment. The woodwork is given a natural varnish finish while the iron work is finished in black.

The clearance between the inside girders is 28 in. The unit is 40x72 in. and has a height of clearance of 13 to 13¾ in. The weight of the platform is 450 lb. and its capacity is 4,000 pounds.

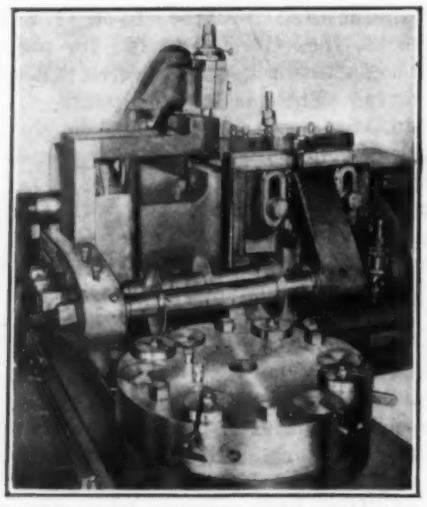
SHOP EQUIPMENT NEWS

Bilton Pro-Ducto-Matic No. 8

The No. 8 "Pro-ducto-matic" milling machine recently has been developed by the Bilton Machine Tool Co. of Bridgeport, Conn., and is now on the market.

The new member of this family of machines retains the characteristics of its mates in the matter of drive and spindle movement but is adapted to carry two spindles instead of one in the head, which is attached to the face of the vertical slide.

The turret is disposed in a horizontal position, to rotate about a



Bilton Pro-Ducto-Matic, No. 8

vertical axis, and fixtures of various kinds are provided to set into the flat top of the turret to hold different kinds of work. The indexing mechanism is so designed that the turret can be stopped either in four or six positions per cycle as desired.

The work to which the machine is particularly adapted is castellating nuts, milling the faces of hexagonal nuts, or similar work on any machine part. To produce this class of work both spindles are used with the proper set-up of cutters, and the six-stop cycle is employed. On work requiring two or more cuts at right angles the mechanism is adjusted to the four-stop cycle and the rear spindle remains out of service.

The turret is bored to receive fixtures in four or six stations, corresponding to angles of 90 or 60 deg. respectively, and round covers are provided to blank the positions not in use. An automatic clamping device is furnished to hold the work while under the cut. Work is ejected by the hand levers to be seen in the illustration.

The machine weighs approximately 3,500 lb. and occupies a floor space of 42x60 inches. It may be driven by belt from an overhead shaft or by an independent motor suspended below the pan. Pump, tank and conduits for a cooling medium are supplied if desired.

Lapointe Keyway and Bearing Broaches

Two sets of keyway broaches and a series of broaches for use on connecting-rod main bearings and piston-pin bushings are being manufactured by the J. N. Lapointe Co.,

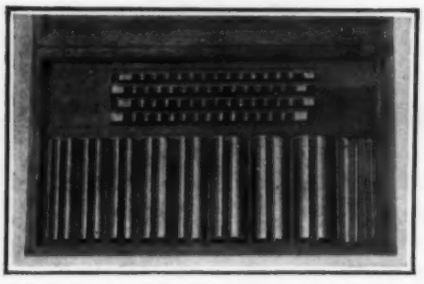


Fig. 1—Lapointe Keyway Broaches

New London, Conn. The two keyway sets are the "Handy," and the "Giant" set which is illustrated in Fig. 1, the former for broaching keyways from $\frac{1}{8}$ to $\frac{1}{4}$ in. in size in work from $1\frac{1}{2}$ in. to 2 in. long.

The capacity of the "Giant" set is 32 keyways, as follows: $\frac{5}{32}$, $\frac{3}{8}$, $\frac{7}{16}$ and $\frac{1}{2}$-in. keyways in work up to 6 in.

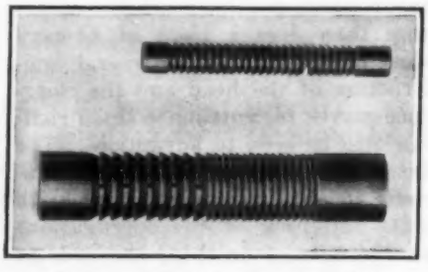


Fig. 2—Bearing and bushing broaches

long. The diameters of the work bushings are: $1\frac{7}{16}$, $1\frac{9}{16}$, $1\frac{11}{16}$, $1\frac{13}{16}$, $1\frac{15}{16}$, $2\frac{1}{16}$, $2\frac{3}{16}$ and $2\frac{7}{16}$ inches.

Each of the sets is furnished with shims and with work bushings for inserting in the holes in which the keyways are to be cut. All cutter bars are interchangeable with each work bushing. Specially shaped cutter bars may be had to order.

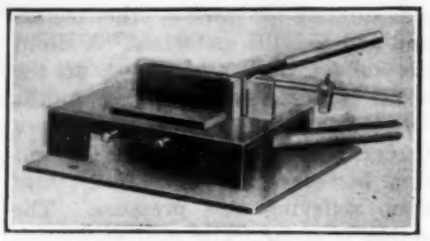
The round broaches for bearing work, illustrated in Fig. 2, are made in 21 sizes ranging from $\frac{3}{4}$ to $2\frac{1}{4}$ in. and in standard diameters of oversize from 0.0025 to 0.015 inches.

The tools are intended for use on arbor presses in cases where the use of a broaching machine is unnecessary.

Dreis & Krump Manufacturing Co. "Buckeye" Bender

The Dreis & Krump Manufacturing Co., 74th St. and Loomis Blvd., Chicago, Ill., has developed and placed on the market the all-steel "Buckeye" bender, illustrated.

The machine base is a steel plate 12 in. square. The body is made from an inverted channel section



Dries & Krump Manufacturing Co. "Buckeye" Bender

and arc-welded to the base. The material to be bent is clamped between two angle bars. Two set-screws are used to regulate the clamping adjustment. It is said to be easily adjustable to various lengths of stock and to be capable of bending flat and round bars, also notched bars, to a 90-deg. angle. A movable drop gage is provided to facilitate the making of duplicate short bends.

The bending leaf is a hardened steel section which bears on both the lower plate and the channel. Its capacity is $\frac{1}{4}$x2 in. in mild steel.

The construction of the machine is very simple and light so that it is easily portable. Holes are provided in the base so that it can be bolted to any bench or to a table-truck on which it can be moved to any point desired.

Rustproofing of Materials

By M. E. McDonnel
Chief Chemist, Pennsylvania Railroad System

IN THESE days when a fight is being made for the elimination of waste and the conservation of our resources, the extent of the damage due to rust and corrosion of metals in this country is receiving wide recognition. In his annual address before the American Society for Testing Materials, in June of this year, Pres. F. M. Farmer estimates that in this country we are losing $300,000,000 annually because of corrosion.

The research department of the Pennsylvania Railroad System has been actively studying rust and corrosion for years and the protective measures suggested by experiment have been applied on a broad scale by the management.

In considering the effect of the destruction of steel due to rust, it should be remembered that the loss of 1,000 tons of steel gives a depletion in our natural resources equivalent to 2,000 tons of ore, 4,000 tons of coal, more than 500 tons of limestone, together with losses of magnesite, chromite, manganese and other materials, and even now most of our manganese ore is being imported. The labor required in assembling these materials involves a large number of "man hours." Rust and corrosion frequently impair the strength of structures and thereby endanger lives.

Change Called Corrosion

In nature the metals usually used for structural purposes normally occur as compounds such as oxides or sulphides, and not in the free metallic state. Through metallurgical operations of an artificial character, involving high temperatures and reducing atmospheres, the materials are obtained. Under the influences of nature these metals normally revert to the same type of compounds from which they were originated. The structural materials used by the engineer are not in equilibrium and all of them are under a potential pressure to revert to a balanced state. This change of state is commonly termed corrosion.

Engineers now know that commercial steel on the market varies greatly in its tendency to rust. On Aug. 1, 1912, we exposed fifteen weighed commercial sheets of steel on the roof of the locomotive test plant in Altoona. These sheets were carefully analyzed and on Feb. 13, 1913, after six and one-half months of exposure, they were wire-brushed and re-weighed. It was found that the rate of rusting varied much, the minimum loss being 30.12 grams and the maximum being 84 grams on the two sides of a square foot of the various sheets tested. It was especially evident that the sheets containing copper showed the lowest losses in weight. The tests were largely instrumental in bringing about the decision of the Pennsylvania management to adopt copper bearing steel for car roofs.

Another illustration of the variation of the durability of steel is the test that was given to a lot of two hundred fifty-eight 16-gage steel and two hundred thirty 22-gage sheets of plain carbon and copper bearing steel which was exposed for test purposes in Pittsburgh, on Dec. 12, 1916, by a committee of the American Society for Testing Materials of which I had the pleasure of being a member. After sixteen months of exposure some of the sheets contained holes or ragged edges. Thirty 22-gage plain carbon sheets failed in that time. After twenty-eight months of exposure some of the panels had entirely turned to rust. The number of 22-gage plain carbon failures had increased to seventy-seven, or more than 92 per cent of this class of sheets. During the same period only six 22-gage copper bearing sheets had failed, and it should be stated that none of them contained manganese. After seventy-five months of exposure many of the panels had entirely disappeared as rust. At the end of the period every 22-gage plain carbon steel sheet had failed while twenty-three copper bearing 22-gage sheets were free from holes or ragged edges. Also, at the end of that period one hundred two of the one hundred twenty-six 16-gage plain carbon steel sheets had failed, while there was not a single failure among the one hundred thirty-two 16-gage copper bearing steel sheets. The average life of the copper bearing 22-gage sheets on this test was over forty-nine months, while the average life of the eighty-four plain carbon steel sheets was twenty-three months. The results of this test led the Pennsylvania management, in 1919, to adopt copper bearing steel for all sheet steel to be used in cars.

From the experimental data at hand, it may be assumed that the use of copper bearing steel has extended the time when car bodies must be rebuilt for over a fifteen-year period and repairing with copper bearing steel sheets reduces this repair cost to approximately $3,473,710.30 from $5,069,112.03. This figure represents an annual saving of $1,595,401.73 and an annual reduction of about 22,385 tons in the amount of new steel required.

Another important advantage gained by the reduced number of shopping periods is the increased number of days that the cars are in service. Numerous other economic factors enter into the problem, such as the reduction in ore consumption and the saving in labor.

Those who have had practical experience with steel may have noticed that ordinarily steel forms a light brown, loose rust upon oxidation, while copper bearing steel oxidizes on the surface to a dense, dark brown that is of an adhering nature and this is believed to act as a protective measure against rapid destruction.

Producing a Protective Film

Other similar examples of oxidation protective coatings are well known to the engineer. Copper, bronze, zinc and other substances all deteriorate rapidly at first but form protective coatings. Rustproofing coatings may therefore be induced by the use of a small percentage of an element or ingredient which on oxidation produces a protecting film.

In the absence of copper, a high percentage of sulphur stimulates corrosion. In the presence of copper, a small manganese content improves the resistance of the protective coating formed on oxidation. The presence of chromium in steel increases its rust resisting properties and the so-called stainless steel which is now being used for cutlery and other small parts where great rust resistance is essential, contains about 13 per cent of chromium.

In the presence of oxygen, some natural waters quickly form a protective coating due to the presence of salts carried in solution. Pure water does not form these coatings. New York City water is relatively pure and it has a persistent action on metal pipes. Removal of the oxygen largely eliminates this action. The water supplied to the Hotel Pennsylvania is treated with a

Abstract of a paper read before the regional meeting of the A.S.M.E., held at Altoona, Pa., Oct. 5-7, 1925.

small quantity of sodium silicate to form a protective coating lacked in the original pure water of the city.

Steel for important structures, such as bridges, should receive a shop coat of good paint prior to its shipment from the factory and for this purpose red lead is still a favorite. Steel for rolling stock which is not painted should be stored in a dry place until it can be assembled and if this is not feasible a protective coat of some kind should be applied. The method employed by the Pennsylvania Railroad System is to apply a coating of petroleum oil containing resins and wax to give adhesive properties.

Experiments conducted proved that a minimum amount of drier should be used in paints exposed to the elements. The drier continues to affect the paint long after it has become dry. Good results have been obtained by using temperatures of 250 to 260 deg. F. to bake the paints during drying and to avoid the use of artificial dryers. The coatings dried on passenger cars in a baking oven have been found to be very durable. The early results were so successful that new baking ovens were constructed in different places and more work done according to the same methods. Further extension has been curtailed, however, pending the results of the new lacquer system being developed in connection with automobile painting.

The Pennsylvania Railroad System is now trying the lacquer process and has applied it to five passenger cars and over a hundred locomotives. Tests are still being conducted in connection with the method.

Accurate Machining of Large Spark Gap-Balls

By W. F. Jones
Equipment and Methods Department,
Westinghouse Electric & Manufacturing Co.

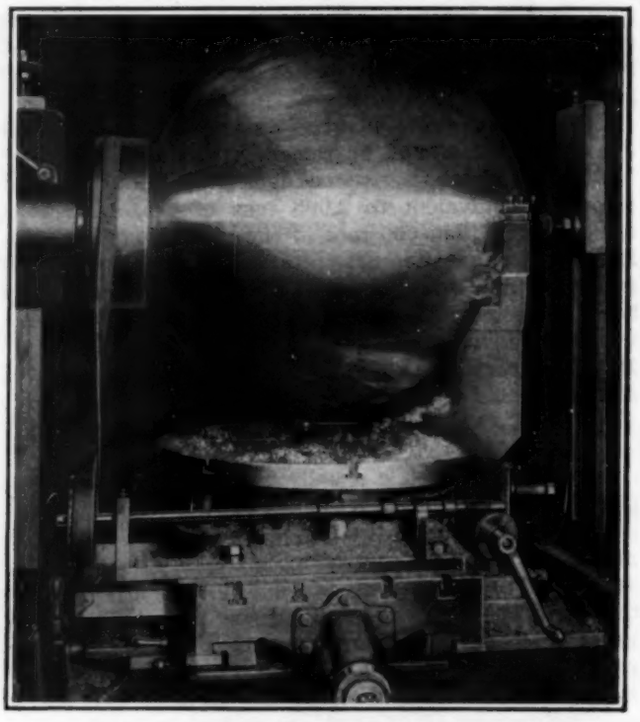
MACHINING a bronze ball may appear ordinary and commonplace. However, when a bronze spark-gap ball, 39¾ in. in diameter, for use with high-voltage testing apparatus, is machined to a tolerance of 0.002 in., the operation takes on an aspect of considerable importance. In order to obtain this accuracy, a feed depending upon the speed of the rotary table, which in this case was constant at 0.027 in. per rev., was used. The depth of the roughing cut was 0.062 in., and that of the finishing cut 0.010 to 0.015 in.

The balls first used for high-voltage testing apparatus were very much smaller and presented no very difficult problem. Sizes up to 19 in. in diameter could be turned on the milling machine, by holding the ball in a chuck attached to the spindle and using a circular attachment on which a special tool holder was mounted. On the largest size it was necessary to use a tail-center support.

Turning a ball, 39¾ in. in diameter, however, is an entirely different matter. The particular ball used in connection with the high-voltage testing apparatus at the Sharon Works of the Westinghouse Electric and Manufacturing Co. is made of a special bronze metal. It is cast hollow and in halves. One half of the ball is provided with a collar that is used for assembly on the terminal to which it is attached, and which greatly facilitates the chucking as shown in the illustration. The other half of the ball has a small, square lug, used for a tail center support. Each half of the ball is placed on a vertical boring mill where it is trued up so as to properly distribute the metal to be turned off after the halves are joined.

After the facing off process has been completed, one half is turned and threaded while the other half is bored and threaded to suit. Before these pieces leave the boring mill, the collar is turned and the square boss or lug is centered. The two halves are then screwed together and the ball placed on the horizontal boring machine shown, for turning.

In order to carry on the operations, a special chuck was made and fitted to the machine spindle, into which the collar of the ball was fitted. A center was fitted



Turning large ball on Lucas boring machine

into the outboard spindle-bearing. The center was provided with a thread and nut to allow tightening as the center hole became worn.

The work table of the machine was securely fastened and to it a rotary table was attached, after being carefully trued up with the center line of the spindle. A special toolpost was then fitted to one of the T-slots in the rotary table. While the rotary table was not originally arranged for power, it required but little work to fit it with power feed by a belt connection. The outside of the chuck provided a very good drive pulley for the belt which drove a pulley on the shaft located at the front of the machine. This shaft was arranged with adjustable collars so that the worm could be disengaged from the wormwheel when hand adjustment of the table became necessary.

The total weight of the ball shown in the photograph is approximately 222 lb., and the rough-wall thickness is about ¾ in. The thickness is about ⅜ in. when finish turned.

After the ball has been finish-turned, it is polished with three grades of abrasive, (rough, medium and fine) using oil with each grade. The square lug or center boss is sawed off, after the ball has been removed from the machine and this point on the ball is filed to a templet.

News of the Week

Development of Safety Movement Features Forty-Sixth Convention of A.S.M.E.

Secretaries Hoover and Davis among prominent speakers

Addresses by Secretary of Commerce Herbert C. Hoover, Secretary of War Dwight F. Davis, Assistant Secretary of War Hanford MacNider and President William Green, of the American Federation of Labor, marked the forty-sixth annual meeting of the American Society of Mechanical Engineers in New York, Nov. 30 to Dec. 4, 1925. More than 2,000 members from all over the country attended the meeting. Honorary memberships were conferred on Secretary Hoover and on Worcester R. Warner, of the Warner & Swasey Co., Cleveland.

At the president's reception Dr. William F. Durand delivered the president's address, his subject being "The Engineer and Civilization." After the conferring of the honorary memberships the official report of the tellers of election was given announcing the election of William L. Abbott, of Chicago, as president; A. G. Christie of Baltimore, Wm. T. Magruder of Columbus, and Roy V. Wright of New York as vice-presidents; Eric Oberg, of New York, as treasurer; and Robt. L. Daugherty of Pasadena, Wm. Elmer of Altoona, and Chas. E. Gorton of New York, as managers.

Dr. Michael I. Pupin, president of the American Institute of Electrical Engineers, was the principal speaker at the annual dinner. Drawing on his early struggles as an immigrant boy in the United States for examples, Dr. Pupin stated his belief that his mastering of the two arts of handling a team of mules and managing a boiler room had done much to help him in his later work. "Mules," he said, "may be taught to love and honor a man but never to obey him." This mastery calls for every bit of tact and other virtues possessed by man, and is therefore to be compared with the mastery of scientific problems wherein the same virtues are demanded. Citing George Washington and Benjamin Franklin as outstanding examples of the practical idealist type of engineer, Dr. Pupin claimed for the engineering profession many other men of the same type but of less prominence.

The usual custom of calling on the new members to rise and be recognized was followed and at its conclusion Past-President F. R. Low, editor of *Power*, delivered a charge to them explaining the aims of the society and their responsibilities as members.

At the business meeting and general session, at which Wm. F. Durant, president of the society, presided, the Chas. T. Main award was presented to Clement R. Brown of Catholic University, Washington, D. C., the junior award to Gilbert S. Schaller, assistant professor of engineering shops, University of Washington, Seattle, Wash., and student awards to E. Ray Enders, Jr. and Wm. S. Montgomery, Jr. (joint) of Pennsylvania State College, State College, Pa., and to Harry Pease Cox, Jr., Rensselaer Polytechnic Institute, Troy, N. Y.

Engineering Education Neglects Fundamentals

The following papers were presented at the meetings of the Machine Shop Practice Division and were characterized by thorough discussion:

"The Tension Ratio and Transmissive Power of Belts," by C. A. Norman.

"Principles and Advantages of Optical Methods for Measuring Machine Parts," by Henry F. Kurtz.

"Some Comparative Wear Experiments on Cast-Iron Gear Teeth," by G. H. Marx, L. E. Cutter and B. M. Green.

"Normal Pitch—The Index of Gear Performance," by G. M. Eaton.

"The Question Mark in Machine Design," by Forrest E. Cardullo.

Mr. Cardullo's paper was presented in full in the *American Machinist*, issue of Dec. 3. The papers by Messrs. Marx, Cutter and Green; Kurtz; and Norman were abstracted in the same issue. An abstract of the paper by Mr. Eaton appears in this issue.

Seven papers were presented at the session on springs and their reception and the amount of discussion that followed indicated the importance of the subject of springs and the amount of attention that is being given to it by engineers and designers.

J. L. Harrington, a past president of the society, gave a report of the A.S.M.E. study of mechanical engineering education, a study that has been conducted for the Society for the Promotion of Engineering Education as part of a complete investigation of engineering education. This report indicates that it is the opinion of practicing and employing engineers that engineering schools are now giving courses based too much upon proficiency in technical subjects without devoting enough time to training in fundamental scientific subjects, cultural subjects and economics and accounting. The report also indicated that engineers are doubtful as to the advisability of teaching foreign languages in engineering schools unless they are taught late in the course or their study is made optional.

Reports on progress and prospects in mechanical engineering covering the fields of the professional divisions of the society were presented by the chairman of those divisions. W. F. Dixon presented the report of the Machine Shop Practice Division; R. T. Kent gave the report of the Management Division; and J. A. Shepard presented the report of the Materials Handling Division.

The Robert Henry Thurston lecture was given by Dr. Zay Jeffries of the Aluminum Co. of America, Cleveland, Ohio. His subject was "Engineering and Science in the Metal Industry." The Thurston lectures are tributes to the memory of Robert Henry Thurston, first president of the society. They deal with subjects in the zone between engineering and science and present the latest knowledge in the field in which Mr. Thurston was a notable pioneer.

Materials Handling in Shop Planning

The first paper of the Materials Handling Session, at which James A. Shepard presided, was prepared by F. D. Campbell who explained that the reason for its comparatively elementary nature was in order to appeal to the business men of manufacturing concerns rather than to the engineers, who already knew many of the problems. He pointed out that one reason for much of the old, laborious material handling in shops was because management had not yet discovered how expensive it really was, and that proper equipment was frequently a great saver of dividends. In one instance cited an investment of $100,000 paid for itself in less than a year.

Discussion was animated, taking up all the phases pointed out by the author and adding new ones as well. H. B. Coes suggested that, as with other production mechanisms, the man who got along without them usually paid for them yearly in unnecessary wages, without getting the machinery in the plant as an asset. Several reported a change in the attitude of management toward materials handling equipment and felt that it was becoming more and more a part of all shop planning.

One interesting point brought out was that a proper appreciation and

application of handling devices could easily save large amounts in the construction of shop buildings. An instance was cited where the usual method of plant layout with successive operations in line, would have placed very heavy punching and blanking machinery on the top floor. This would have required extremely heavy construction for the building and added greatly to the cost. By breaking the sequence of operations and putting this machinery on the ground floor, or even in the basement, and installing modern equipment for automatically handling the material to and from the main operation line, production was not disturbed and very large savings were made in the cost of the building.

On the other hand cases were brought out where so many conveyors had been installed that they hardly left room for production work. This emphasized the necessity of recognizing material as a part of production but as distinct from the actual machining processes. Two manufacturers of material handling equipment said that their sales engineers were taught not to oversell a customer and not to recommend their own product when another might be better suited to the particular conditions. In other words not to sell their equipment unless they would buy it for their own plant. M. W. Potts brought out the point that all forms of moving material from one point to another must be considered, whether by hand, wheelbarrow or by the latest mechanical devices.

The question of the effect of handling equipment on overhead was discussed from various angles and widely different opinions were expressed. L. P. Alford voiced the hope that industrial engineers would carefully consider the development of a method for applying what is equivalent to a machine-hour rate to material handling equipment.

David S. Beyer presented a paper, "Safety in Materials Handling," an extract of which appeared in last week's issue. This was followed by a "Progress Report" on the application of materials handling formulas, by James A. Shepard.

Management the Function of Trained Engineers

A joint session of the management division and the Taylor Society on Thursday morning listened to papers on "Influence of Plant Design on Plant Efficiency," by Harold T. Moore; "Production Control in the Newsprint Industry," by George D. Bearce; "Carbon Dioxide as an Index of Fatigue," by Walter N. Polakov. After a discussion on the teaching of management engineering a resolution to the effect that management is essentially an engineering function and should be taught under the direction of engineering educators was passed with the further provision that the council be urged to make a pronouncement to this effect.

Another joint session in the afternoon considered industrial psychology. "The Present State of Industrial Psychology" was the subject of an interesting address by Mrs. Lillian M. Gilbreth. Edgar A. Doll read a paper on "Psychology in the Organization of Prison Industries."

Deplore Accidental Deaths in U. S.

The session under the auspices of the aeronautic division was opened by Archibald Black's introduction of Grover Loeing as the presiding officer.

At the request of President Durand the session took a recess of one minute in silence, for the consideration of what each member could do to lessen the great number of accidents that now take such a toll of lives in America. The deaths per thousand, as has been pointed out before, is about double that in most civilized countries and four times those in Denmark.

Airship for Long Flights

The first and second papers were read, in the absence of their authors. The first, by Lt. Col. H. H. Blee on "The Airship and Its Place in Commerce," gave a general survey of the development of lighter-than-air craft, with special attention to its commercial possibilities. The paper began with a brief history of airships, including the effects of Santos Dumont, Leo Stevens and others even earlier. Harrington Emerson told of one that he saw, as a boy in Paris in 1865. Col. Blee feels that for long flights, of from 2,000 to 4,000 miles, the airship has a field distinct from the airplane. He spoke of the relative value of hydrogen and helium gas and expressed the belief that the cost of helium might be greatly reduced in the future. Theoretically the lift of hydrogen may be called 71 and of helium 66, with costs of $2.75 to $10 for hydrogen and from $50 to $60 for helium at present. Harrington Emerson felt that this did not present the actual difference in lifting value, but that, when all things were considered, helium was not much over half as efficient as hydrogen. He urged the use of low grade fuel engines to greatly lessen the fire hazard with hydrogen.

The paper on "Maintenance and Depreciation of Airplanes and Engines," by Lt. Ernest W. Dickmen, was especially interesting and valuable, giving data covering a 21-month period on over 100 army planes at Kelly Field, Texas. He feels that a plane should be good for 200 flying hours without overhaul and that 8 overhauls should be possible before scrapping the plane. Engines give 150 hr. running before overhaul and are good for 12 overhauls. Mr. Black commented on this paper and added some interesting figures from the Air Mail Service and from other sources.

Under the title "Technical Progress at McCook Field," Lt. E. E. Aldrin gave a very interesting and instructive paper on the work being done at McCook Field. Mr. Loening spoke of the fine work that had been done in engine design and that was available for engineers interested in airplane engine work. Lt. Aldrin's paper included planes, engines, landing gears, radiations, instruments. There was naturally some difference of opinions on various points, all adding to the interest in the paper.

The only adverse criticism of the work at McCook Field was that, probably due to the publicity man being over-zealous, claims for design and development were sometimes made when in reality the word "tested" would have been correct. In view of the excellent work done in many lines this is rather unfortunate as it tends to raise a doubt as to just how much is original work and how much has been developed elsewhere. Lt. Aldrin made a splendid impression and can do much to counteract unfavorable comment that has arisen.

Taylor Society Symposium on Management

At an individual meeting the members of the Taylor Society listened to seven speakers at a symposium on "The Relations of the General Manager and His Principal Executives."

The society plans a study of the function of the chief executive aiming at "job analysis" of the position of chief executive.

This symposium gave the society an opportunity to hear the judgments concerning the relations of the chief executive to his principal staff associates of the seven chief executives who spoke. The speakers were: Howard Coonley, president, the Walworth Company, Boston, Mass.; Henry S. Dennison, president, Dennison Manufacturing Co., Framingham, Mass.; A. Lincoln Filene, general manager, William Filene's Sons Co., Boston, Mass.; H. W. Jeffers, president, Walker-Gordon Milk Co., Plainsboro, N. J.; Samuel W. Reyburn, president, Lord & Taylor, New York; Rumsey W. Scott, president, American Cable Co., New York; and Percy S. Straus, vice-president, R. H. Macy & Co., New York.

Industrial Co-operation with War Office

The last session of the convention was a meeting on industrial co-operation with the War Department, at which Frank A. Scott acted as temporary chairman. The meeting opened with the ceremony of the 24th Engineers presenting their colors to the Engineering Societies as a memorial to the work of the engineers during the war. The presentation was made by Col. Whitlock and the colors were received by W. L. Saunders. After a short opening address Mr. Scott introduced Elbert H. Gary as the permanent chairman. Mr. Gary first read a message of greeting from President Coolidge and then commented on the report of the Morrow Board on Aviation, voicing the hope that the national defense may not become a football of partisan politics. He then outlined the war record of Secretary of War Davis and introduced him to a most friendly audience.

Among other points brought out by

Mr. Davis were the little known peacetime activities of the Army, claiming that its greatest work was done in times of peace, and pointing to the Panama Canal, the work in rivers and harbors, the development of the telephone and radio and the practical uses made in saving money that would otherwise be spent for telegrams. The work of the Chemical Warfare Division in peaceful investigation was shown in its conquering of the boll weevil and the fumigation of ships in which the hazards had been almost entirely eliminated.

The keynote of the meeting was that industrial preparedness was not a preparation for war but an insurance for peace; that the real meaning of preparedness was the synchronization of the mobilization of men and material. The Secretary's appeal for "no slacking and no profiteering" met with hearty applause.

Assistant Secretary MacNider, who also has a real war record and citations for bravery, followed his chief. He told of the admirable work that had been done in the department in securing the co-operation of manufacturers who would have to supply materials in case of war. He pointed out that industry was always ready to help but that it wanted something tangible, and this had been given by Secretary Davis while he was Assistant Secretary. Mr. MacNider asked for a continuance of the co-operation under his administration.

Assistant Secretary MacNider was followed by Gen. James G. Harbord, now president of the Radio Corporation of America, who had much to do with the development of radio in the army.

Power Show Visualizes Progress in Plant Engineering

The fourth annual National Exposition of Power and Mechanical Engineering which was held in the Grand Central Palace during the week of the convention, offered an excellent opportunity for engineers and plant executives to become acquainted with the most modern of mechanical apparatus designed for the factory or power generating plant. Over four hundred manufacturers of such equipment exhibited their products at the show.

An outstanding feature of the show was the size of some of the equipment that was installed for this exhibit. A coal pulverizer rated at 12,000 lb. per hour, a 2,000 cu.ft. per min. compressor, direct-connected to a synchronous motor, five sections of a lead-lined economizer, and a stoker designed for service under an 8,000 sq.ft. boiler, were among the larger installations.

A noticeable improvement was seen in the number and the construction of the working models of equipment that were shown by many of the exhibitors. Taking the show as a whole, the power plant was that part of the power house that was very much in evidence. All sorts of equipment, from meters, valves and refractories, to boilers, stokers and pulverizing equipment was shown.

Conference at Washington Adopts Simplified Program for Self-Opening Die Heads

List of sizes shows reduction of 75 per cent

Recommendations embodying a reduction of 75 per cent in the sizes and varieties of chasers for self-opening die heads, used in automatic screw-cutting machinery, were adopted by a general conference of manufacturers, distributors and consumers held Dec. 4 in Washington under the auspices of the Division of Simplified Practice of the Department of Commerce. The recommendations previously had been worked out by manufacturers and various organizations and the tentative suggestions were adopted with little debate by the general conference, which assumed the nature of a ratification meeting.

The product is used in a wide variety of mechanical wares, sewing machines, locomotives, power plants, typewriters, automobiles, electrical goods, etc., and the program adopted by the conference, it is estimated, means a potential saving of $500,000 annually to manufacturers and distributors and indirect savings to all users of machine screws through interchangeability of parts.

Will Support Changes

E. W. Ely, of the Simplified Practice Division, who presided at the conference, read communications from a large number of organizations, machine tool manufacturers, motor corporations, and others, expressing approval of the tentative recommendations and expressing their willingness to support the reductions adopted by the conference.

The program adopted was in line with work done by the National Screw Thread Commission and the American Engineering Standards committee, and helps to bring about a more general use of the results of the studies of the Screw Thread Commission.

After discussions of the program by members of the Screw Thread Commission, the American Railway Association, American Electric Railway Association, American Society of Mechanical Engineers and others attending the conference, the recommendations were adopted to become effective April 1, 1926, for one year.

A standing committee comprising manufacturers, machine tool builders, mill supply dealers, and large consuming groups will be named later to watch the application of the simplification in this field, receive suggestions, and, if possible, to develop further reductions. The program may be revised after one year from its effective date as experience or necessity may dictate.

Those attending the conference included: Henry S. Beal, the Jones & Lamson Machine Co., Springfield, Vt.

H. W. Bearce, the National Screw Thread Commission, Washington, D. C.

J. G. Benedict, the Landis Machine Co., Waynesboro, Pa.

C. W. Bettcher, the Eastern Machine Corporation, New Haven, Conn.

Wm. J. Burger, the Warner & Swasey Co., Carnegie Ave., Cleveland, Ohio.

C. K. Chapin, the Murchey Machine and Tool Co., Detroit, Mich.

H. J. Crain, the Packard Motor Car Co., Detroit, Mich.

R. H. Dalgleish, the Capital Traction Co., Washington, D. C., also American Electric Railway Association.

Ralph E. Flanders, the Jones & Lamson Machine Co., Springfield, Vt.

A. G. Follette, the Pennsylvania R.R., Phila., Pa., also Purchase and Stores Div., American Railway Association, New York, N. Y.

E. G. Herndon, the Bureau of Engineering, Navy Department, Washington, D. C.

James W. Hook, the Geometric Tool Co., New Haven, Conn.

C. E. McArthur, the Modern Tool Works, Erie, Pa.

F. C. Nichols, Navy Department, Washington, D. C.

F. Dana Payne, the Modern Tool Works, Erie, Pa.

E. C. Peck, the American Society of Mechanical Engineers, Cleveland, Ohio.

Aug. A. Rickert, the Rickert Shafer Co., Erie, Pa.

J. W. Sneyd, the Geometric Tool Co., New Haven, Conn.

R. M. Hudson, chief, E. W. Ely and E. L. Priest, Division of Simplified Practice.

To Combine Schooling With Apprenticeship

Robert E. Newcomb, superintendent of the Deane works of the Worthington Pump and Machinery Co., Holyoke, Mass., is chairman of a committee appointed by the Western Massachusetts branch of the National Metal Trades Association, which has reported a plan combining apprenticeship training in factories with supplementary schooling, which the association will try to have introduced in the plants of that district in the near future. On the committee with Mr. Newcomb are these superintendents: George Bagnall, of the Rolls-Royce of America, Inc.; Charles H. Johnson, of the Van Norman Machine Tool Co.; T. L. Loose of the Indian Motorcycle Co., and Paul Langhammer, of the Package Machinery Co.

Use of Babbitt Increases

The Department of Commerce announces total apparent consumption of babbitt metal, based on reports received from twenty-seven firms, as 5,550,247 pounds in October, as compared with 4,621,033 in September. This consumption is calculated from sales by manufacturers and consumption by those firms (among them several important railroad systems) who consume their own production.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IT HAS long been known that blessings brighten as they take their flight, but in the stock market it is also true that ogres lose their terrors as they approach.

A month ago the *bete noire* of the stock market was the prospect of an advance in the rediscount rate of the Federal Reserve Bank of New York which seemed to be approaching with relentless tread. First came the warning in the increase of the Boston bank rate from 3½ to 4 per cent, followed quickly by similar advances at Cleveland, Philadelphia and San Francisco, until the Federal Reserve Bank of New York stood alone in maintaining a rate of 3½ per cent. Finally, it seemed that the failure of the Bank of England to raise its discount rate was the only remaining check to an advance in the New York rate.

Thus, it has been widely held that the Federal Reserve authorities had agreed not to raise the New York rate until the Bank of England had advanced its rate.

On last Thursday the Bank of England raised its discount rate from 4 to 5 per cent, and the expected moment had arrived. But the Federal Reserve Bank of New York failed to announce any increase in its rediscount rate at the weekly meeting of the directors. The ogre, when seen close at hand, proved to be a man of straw.

The increase in the London rate was found necessary to check the outflow of gold, which has amounted to £19,000,000 since the bank rate was reduced in October, and more than £10,000,000 since the gold standard was resumed last spring.

The combined statement of the Federal Reserve Banks shows a reserve ratio of 70.5 per cent as against 71.1 per cent for the preceding week, and a loss of only $3,000,000 in gold holdings. Even those who fear the rapid growth of governmental control over credit and prices must admit that the Federal Reserve Board is handling a complex situation with extreme tact and circumspection. Apparently the lesson of 1920 was not learned in vain.

The stock market seems to have lost the unsinkable buoyancy that characterized it two weeks ago, but it is in a fairly orderly condition. President Coolidge's unofficial intimation that he is strongly in favor of railway consolidation, has been reflected in the buying of some railroad stocks.

But the stock market is coming to occupy a rather less prominent place in the speculative arena, where the commodity markets are now attracting the limelight of public attention.

The most striking example is seen in the case of wheat which has advanced more than 40 cents from the low of two months ago, and is now at the highest level for the current crop year.

What's Doing in Industry

Entering the last few weeks of the current year, machine tool business is quite satisfactory. Sales continue to be made in unexpected quarters, and new inquiries give unmistakable evidence of business that is to be placed immediately after the first of the year.

Sales in Detroit continue to keep pace with the advance in motor car production, special machines being in better demand. Manufacturers and dealers in Cincinnati report a satisfactory volume, with plants running at capacity.

A steady advance in sales in the first week of December is reported from Milwaukee, and Cleveland shops are working full time to complete present orders. Business in Chicago in the last part of November slowed down, but has picked up gradually so far in December. New York, Philadelphia and the Southern territory all show a steadiness in demand, with a bright outlook for the new year.

Latest figures compiled by the Department of Commerce show an increase in machine tool exports of $200,000 in October, as compared with the figures for the same month last year. Gear cutting machines, milling machines, internal grinders and portable pneumatic tools lead in the value of shipments.

The trade outlook throughout the country is excellent, distributors are buying more freely and the money market is steadier.

Partial crop failures in Australia and the Argentine, and Russian shipments that were below expectations, are given as the technical reasons for this change of sentiment, but there is also evidence of speculative participation by the public. Corn, oats, and rye are also stronger in sympathy with wheat.

Sugar has shown increased activity as a result of a report issued by the Cuban government, in which the Cuban crop was estimated at only 4,800,000 tons. After the publication of this report, the sugar market receded somewhat, but it plainly is becoming broader and there are indications that the crop estimating habit will soon be as general in the sugar trade as it is in cotton.

The metal markets are puzzling. The steel industry is now operating at 85 per cent of capacity, demand is strong and prices slightly higher. The same conditions prevail in pig iron. The non-ferrous metals, on the other hand, copper, tin, lead, and zinc, are inconsistently lower. The reasons for this anomaly are not clear, but some who claim to know attribute it to the slackness of the European demand.

About the only clouds on the horizon are the land booms, and the overbuilding now reported in various parts of the country.

One real estate expert in New York calls attention to the fact that 12,000,000 sq.ft. of new floor space have been added to the midtown business district of the metropolis during the past three years, and he advises against further building of this character for the present.

But the trade outlook in almost every section of the country is still excellent. The Christmas business promises to be enormous, distributors of staple goods are buying more liberally, chain stores and mail order houses report tremendous gains, and everywhere the outlook is reassuring.

Every day brings fresh evidence to prove that the Locarno treaties mark a dramatic turning point in the history of Europe. Everywhere, they are being acclaimed as the most hopeful event since 1914, for sweeping reductions of armaments and the abolition of tariff barriers between nations are now being advocated. In England and in Germany, industry is beginning to raise its head and look toward the future with renewed confidence.

France is still wandering in the maze of her financial difficulties, but her predicament does not seem so hopeless as it did a few weeks ago. Briand is again at the helm of the French government, and his firm hand is inspiring confidence.

The spirit with which Italy has undertaken to liquidate her war debt to the United States is indicated by the fact that more than $2,000,000 has been raised by voluntary subscription to meet the first annual payment to this country.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Chicago

The last half of November ended with a smaller volume of business in machine tools than that recorded for the first half. Sales began to decline as the month advanced, but not to a degree that was unexpected. December opened fairly well in point of inquiries, and dealers generally feel that if they can maintain sales for the month even at a little lower level than those of November balance sheets for the year will show a better return than 1924.

An unusual feature of the season is found in the shortage in deliveries of new metal-working machine tools, more particularly milling machines, manufacturers being far behind in meeting requirements. Prices have advanced in some lines, and there is talk of a corresponding advance in others.

Dealers from Chicago who attended the receivers' sale of the Midwest Engine Co., at Indianapolis, did not buy as freely as they had expected to, the active bidding having forced prices up to figures that rendered it inexpedient to purchase with a view to profitable resale.

Receivers for Earl Motors, Inc., Jackson, Mich., are advertising the entire equipment of that plant for sale, Dec. 8 and 9. The list to be auctioned comprises almost every type of machine tool, and many local machinery men are planning to attend the sale.

Philadelphia

Little change has been noted in the machinery and machine tool industry in Philadelphia during the last two weeks. While most of the larger dealers assert the advance in this line of business has not kept pace with that of other industries, they believe the situation is as satisfactory as could be expected.

Dealers in used machinery and tools have received some inquiries concerning the sale of portable tools, most of which have come from industrial plants in the East. Inquiries from the West and Central sections have not been as numerous as had been anticipated.

With the approach of the end of the year dealers and manufacturers do not anticipate any large volume of business. This applies to the expectations from the railroads as well as from the smaller industrial establishments.

Milwaukee

Nothing has appeared to mar the steady recuperation of the machine tool market, which is proceeding with encouraging momentum. Nearly every day witnesses the appearance of customers who have been absent from the center of buying and selling activities for greater or lesser periods, and are now compelled, or find it desirable, to purchase new equipment to keep abreast of the steady demand for their products.

So well has tool business overcome the spotty characteristics that have dominated the market for a long time that there is no longer any apprehension felt that a decline in buying by a single group, that may have satisfied its needs for the time being, may render trade sluggish if not stagnant. General manufacturing business is on a substantial upward movement and the comment among business men grows more cheerful. Existing plant capacity is being operated at a higher rate than in months past, and the time is drawing near when additional facilities must be provided. Meanwhile every effort is being made to replace equipment with the most modern and highly productive types to obtain the maximum output without extraordinary investment in new buildings. This process is placing on the market a considerable volume of used equipment, but so far there is not believed to be an over-balance that would create concern.

Many believe that December will exceed the conservative estimates previously made.

Cincinnati

With plants running full time, "comfortably busy" seems to be the term which best expresses the condition of the Cincinnati machine tool industry in the past week. The demand, it is reported, is satisfactory, and the business trend is upward.

Orders and inquiries are evenly spread over various parts of the country, and neither any particular line of business nor any section presents an outstanding feature. The largest buying was done by concerns in the automotive industries, but this was almost altogether confined to replacements and single tools.

A number of orders were booked from the steel, electrical and textile industries, and also from makers of small specialties, the majority of these being for replacement.

Railroads did more buying than in the previous week, but this was confined to replacements and single tools. Purchasing agents have sent out inquiries for large lists in the past three weeks, but it is now thought that buying will be deferred until after the first of the year.

Selling agents report that with them the demand improved to some extent in the past week—at least enough to show that the trend is upward. Orders received formed a satisfactory total ranging over a large variety of tools. Buying for expansion is expected after the first of the year.

Southern District

Dealers in Atlanta still report an active demand in spite of the late season.

Inquiries are particularly good, and in sufficient quantity to indicate that there is likely to be little abatement in machinery and machine tool demand through the coming winter, though this is expected to slow up a little in the last half of December.

Considering the volume as a whole, however, business right now is only slightly better than normal, though it continues to exceed the corresponding period of last year by a fairly good margin.

Railroads in the district are still buying quite actively of heavier equipment, and will probably continue good buyers as there is every indication that shop and terminal construction will continue through the winter months.

The textile industries are buying fairly well, and with an unusually large number of new textile mills now in construction in the various Southeastern states this industry is expected to continue a fairly good buyer.

Small shops and service stations are not buying to any extent right now, but the outlook for the early part of 1926 is exceptionally good. What buying these industries are doing now is in used or rebuilt equipment.

Dealers nearly all agree that an excellent volume of business is in prospect for the early part of the coming year. Railroads, textile plants and the wood-working industries are expected to be among the most active buyers early in 1926.

Cleveland

Manufacturers of machinery and dealers in machine tools are enthusiastic about conditions in this industry. Gains in sales and inquiries are evident here, all plants are working full time and indications are that business is going to continue better. All sources of information are of the opinion that present sales are beyond expectations and that the future looks good. To back up the above statements manufacturers cite orders received and new inquiries pending.

The construction of new factory buildings, according to building permits issued, shows a gain of 40 per cent over 1924.

Railroad inquiries are quite plentiful. Automotive industries are also leading factors in the purchase of new equipment.

New York

The first week in December brought little change in the trend of machine tool business in this market. Inquiries continue to appear in good number, although orders are slower in closing. A large volume of business is not looked for in December, as the holiday season and the revision of annual appropriations retards the placing of orders.

The export market is growing steadily, recent political developments opening the way for further expansion in certain lines of industry on the other side.

Large manufacturers of various products have been the best buyers of machine tool equipment. Among those who placed orders for tools in the past week were: Charles E. Larson & Sons, the Ingersoll-Rand Co., the McKinney Steel Co., the Chesapeake Corporation, the American Cast Iron Pipe Co., the Morse Twist Drill Co., the Wildman Manufacturing Co., the Westinghouse Electric and Manufacturing Co., and the North Eastern Electric Co. Machines ordered included lathes, radial drills, profiling machines, grinders and thread hobbing machines.

Detroit

Sales of machinery and machine tools in Detroit and other automobile centers of Michigan is keeping at a high figure for this season of the year, the volume of orders paralleling the production of cars which in October reached a new high monthly figure for all time.

Ford, Packard, Dodge, Cadillac, Hudson, Chrysler and Studebaker are buying in considerable quantities. Much of the new equipment is of a dual nature, permitting its use in more than a single operation. Motor-driven units are largely in demand. Special machinery accounts for the major portion of sales, although standard equipment is finding a ready market.

Engineering plans are progressing for the introduction of a large six-cylinder car by the Chrysler plant on which production is scheduled to start in a large way in the near future. The new Chrysler model is expected to be an important factor in the company's operations during 1926.

Sub-bids for the assembly plant of the Cadillac Motor Car Co. have been let, and the executives are beginning to place the orders for machinery and tools.

Employment in Detroit exceeds that of any period in the city's history.

News of the Automotive Industry

High production of motor cars in October, which established a new monthly record with a total above 400,000, has led to the impression in many quarters that the automobile industry, intoxicated with prosperity this year, had again run riot and was sowing the seed for such reversals as were witnessed in 1920 and 1923. This is far from the actual condition of affairs, as the record in October was established despite the fact that most of the country's automobile factories had already applied the brakes to their production, and were working on smaller schedules because of reduced retail and dealer demand.

Automobile manufacturers are shipping cars to various points in south Georgia for overland drives to Florida cities. Ninety-two carloads of automobiles left Detroit in one day recently destined for the Florida border. An embargo on automobiles is in effect at principal Florida cities, making direct shipment by rail impossible.

The Studebaker Corporation last week shipped 72 automobiles to Tifton, Ga., for drive-away, and shipments to this point will be continued at the rate of 25 a day. Ford is reported contemplating a ship line from New Orleans to Tampa to supply the Florida West Coast. Hupp shipped a train-load on Nov. 11, and another on the 18th to Valdosta, Ga., where they were met by the Jacksonville and Miami distributor and sent overland to destination.

The Carbide and Carbon Chemicals Corporation, a unit of the Union Carbide and Carbon Corporation, has developed a new anti-freeze compound which is being manufactured in commercial quantities and marketed under the name of "Prestone." Its sponsors describe it as a constant, reliable and safe protection against the damage and inconvenience which result from the freezing of automobile radiator solutions.

Plans are being discussed for the proposed merger of the Chandler Motor Car Co. and the Cleveland Automobile Co., which are now controlled by the same banking interests as separate units. The plan calls for the formation of a new holding company which will operate the separate properties, following the acquisition of the capital stock of both organizations. No opposition is expected to the merger. The combined capacity of the two companies is 300 cars daily.

The Olds Motor Works will add a two passenger coupe to its line. Production of the new model will start about Dec. 15, and it is anticipated that 1,000 or more cars of the new type will be run off the assembly line by the end of the month. Previously only the coach, sedan and touring car in the present line have been produced.

The Jordan Motor Car Co. declared its regular quarterly dividends of 75 cents on the common and 1¾ per cent on the preferred, both payable Dec. 30 to stock of record Dec. 15. President Jordan stated production is running about 65 cars daily which is approximately capacity. Jordan Motor has shipped into Jacksonville, Florida, about 350 cars in the past month.

O. C. Hutchinson, general sales manager of the Hupp Motor Car Corporation, says "We are oversold on our new six-cylinder car and will continue to be oversold the rest of the year. There is already visible evidence of demand for both sixes and eights next year which will necessitate the largest production schedules we have ever known." Unfilled orders Nov. 1 exceeded $4,000,000 in sixes and eights.

"Conditions abroad seem to be steadily improving," said Alexander Legge, president of the International Harvester Co., to a press correspondent last week. "Our German business is probably more than 60 per cent of pre-war, and our average European business is probably about 65 per cent of pre-war.

"I think the English have developed a type of bus and truck that is more economical in the use of gasoline than the American buses and trucks. Our production of buses and trucks next year will be substantially ahead of what it was this year."

Dodge Brothers report overseas shipments of 29,156 cars for the first ten months of 1925, as against 22,964 cars for the same period of 1924, an increase of 32.7 per cent. Speaking of the expansion of export business, Percy Owen, director of foreign sales of Dodge Brothers, Inc., says: "Improved economic conditions abroad and the need of greater transportation facilities has resulted in a greatly increased demand for motor cars. The field for American cars that can be operated at low cost and small fuel consumption is almost unlimited, and demand will continue to increase.

"In 1924 our exports increased 17.5 per cent, whereas total production of cars decreased 11 per cent. This year exports have further increased. As the rest of the world readjusts itself, it must follow America in the greater use of motor transportation."

What the Railroads Are Doing

William H. Woodin, president of American Car and Foundry Co., was elected president of the American Locomotive Co., succeeding the late Andrew Fletcher, at a meeting of directors of the locomotive company.

A statement issued after the meeting said Mr. Woodin is one of the largest owners of the company's stock and has been a director and member of the executive committee for years.

"We are sure of a better opening for 1926 and if agricultural and business conditions shape up rightly during the second quarter the year may well be one of greater railroad traffic and earnings than 1925," says Charles H. Markham, president of the Illinois Central System. A year ago, Mr. Markham predicted for 1925 most evenly-distributed prosperity in this country in recent years.

"Unquestionably, the first four months of 1926 will be more active and railroad earnings will be above those of the early months of this year," he says. "The farmer has definitely joined the ranks of the prosperous. The same is true of the cotton grower."

This month the Baldwin Locomotive Works will start work on the removal of another shop from the Philadelphia plant to Eddystone. The task of removal of the plant from Philadelphia to Eddystone, which has been going on for some years is under direct supervision of Samuel M. Vauclain, president. Work on removal of the frame shop, which was started last August, will be completed in January. The new frame shop is being housed in the shell plant formerly used by the Eddystone Munitions Co., which has been remodeled for the purpose.

More Machine Tools Exported in October

Exports of metal-working machinery for October, with revised comparative figures for October, 1924, as compiled by the Department of Commerce, are as follows:

Exports	Oct., 1924 Value	Oct., 1925 Value
Lathes	$103,029	$113,864
Boring and drilling machine tools	80,057	29,466
Planers, shapers and slotters	31,907	31,409
Bending and power presses	178,915	16,052
Gear-cutting machines	10,707	74,109
Milling machines	68,751	103,228
Thread-cutting and screw machines	29,638	167,094
Punching and shearing machines	6,086	11,658
Power hammers	25,639	9,393
External grinding machines	98,734	89,802
Internal grinding machines	26,968	48,094
Other grinding and sharpening machinery	40,029	68,139
Chucks for machine tools	43,219	26,976
Reamers, cutters, drills, taps, dies and other metal-working tools	208,573	239,101
Pneumatic portable tools	85,179	116,442
Foundry and molding equipment	32,825	78,388
Other metal-working machinery and parts of	367,895	399,179
Metal-working machine tools (total)	$1,438,151	$1,622,394

Business Items

The Midwest Tool and Manufacturing Co. is the new name of the Hanson Tool and Die Co., of Detroit.

The Madison Tool and Stamping Co. of Madison, Wis., has taken over the business of the Bracket Co., Lancaster, Wis.

The Time Saver Manufacturing Co., 2841 N. Clark St., Chicago, has been incorporated to manufacture tools, dies, machinery, electrical and radio apparatus.

Johns-Manville, Inc., of New York, has purchased the plant of the Pollak Steel Co., in Cincinnati, and will begin the manufacture of asbestos products as soon as machinery has been installed.

Page & Ludwick of 14 East Jackson Blvd., Chicago, have been appointed sales representatives in the Chicago territory for the Magnetic Manufacturing Co., of Milwaukee.

The American Equipment Co., of Detroit, has taken on "U. S." electrical drills, grinders and polishers for metropolitan Detroit. The company will handle no other make of electrical tools.

F. W. Jaeger, of 140 Liberty St., New York, has been appointed sales representative in the United States for the new type machine vise manufactured by Ernst Krause & Co., of Vienna.

The Simplex Wire and Cable Co., of Boston, Mass., has opened a branch office in the Lew Bldg., St. Augustine, Fla. F. H. Pettee, who has represented the company in that state for the past two years, will have charge of this office.

The United States Electrical Tool Co., of Cincinnati, Ohio, has opened a New England office at 514 Atlantic Ave., Boston, Mass. Ralph E. Bell has been appointed district manager for New England and will have charge of this office.

The Holyoke Co., Holyoke, Mass., manufacturer of wire for transmission of electric current and other industrial uses, has purchased the plant on Main St., Holyoke, formerly owned by the Century Machinery Co.

The Modern Machine Co. has been incorporated at San Diego, Cal., with a capital stock of $150,000. The incorporators are George E. Toms, John D. Jacks and John G. Dickson. The company will conduct a general machine shop.

A. C. Bisgood of 55 Montgomery St., Bridgeport, Conn., has purchased the machinery business of Gledhill & Co., at 17 Union Square, Bridgeport, Conn.. The business in new and used machinery will be conducted as heretofore.

The Fisher Body Corporation has taken over the plant of the former Saxon Motor Car Co., in Detroit, where bodies will be made shortly after the first of the year for the Yellow Truck and Coach Manufacturing Co., recently acquired by the General Motors Corporation. The coach company recently brought out a new model of taxi-cab, which will be known as the "Mile Merchant."

Rolls-Royce of America, Inc., Springfield, Mass., has acquired the controlling interest in Brewster & Co., automobile coach manufacturers of Long Island City. William Brewster, president of the Brewster company, is to continue in that capacity and will be vice-president of the Rolls-Royce organization. Present plans indicate that the dual organization will continue a manufacturing policy in line with the policy of the individual units. Automobile bodies will be manufactured at the East Springfield plant of the Rolls-Royce company and the building of superfine automobile coaches will go on at the Long Island City plant of the Brewster unit.

Personals

EDWARD W. WEILER has joined the firm of the Eureka Tool and Machine Co., of Newark, N. J.

H. G. HAIGHT has been elected president of the American Forge and Machine Co., of Canton, Ohio.

RAY A. SOSSONG, manager of gas plants for the Air Reduction Sales Co., of New York, has been elected president of the International Acetylene Association.

C. J. THORNE, who has been connected with the sales department of the Turner Manufacturing Co., at Kokomo, Ind., for the last four years, has been appointed general sales manager of the company.

FRED GRAF has been elected vice-president in charge of production of the American Foundry Equipment Co., of Mishawaka, Ind. He was formerly foundry engineer for Frank D. Chase, Inc., of Chicago.

ROBERT R. CUTHBERSON, who has been associated with the Chicago office of Manning, Maxwell & Moore, Inc., for the past twenty-five years, has resigned to join the firm of Stocker-Rumely-Wachs, Co., of Chicago.

J. C. HAGGART, JR., has been elected vice-president of the Republic Motor Truck Co., Inc., of Alma, Mich. Mr. Haggart has been associated with Republic for the past nine years, both as chief engineer and assistant to the president.

C. F. PHILLIPS has been appointed representative in charge of the Wilkes-Barre office of the Allis-Chalmers Manufacturing Co. Mr. Phillips, who was formerly connected with the Philadelphia office of the company, succeeds Guy V. Woody.

S. T. KING, formerly with the United Alloy Steel Corporation, Canton, Ohio, and the Wheeling Steel Corporation, Wheeling, W. Va., has been named superintendent of the full finished sheet department of the Youngstown Sheet and Tube Co., Brier Hill plant, Youngstown, Ohio.

J. W. MYERS, who was formerly connected with the National Acme Co., and also manager of the machinery department in Japan of the Andreus & George Co., has returned to the United States, and will establish himself as a consulting engineer giving special attention to sales problems in the Far East. His present headquarters are in the Winton Hotel, Cleveland.

FRANK O. HOAGLAND has resigned from the Saco Lowell Shops and returned to the Pratt & Whitney works of the Niles-Bement-Pond Co., Hartford, Conn., as master mechanic in charge of all engineering in the combined machinery and small tool departments. He will report directly to the vice-president, C. R. Burt.

FRANK W. HUTCHINGS, former president of the Michigan Manufacturers' Association, has been appointed special representative of the Department of Engineering Research of the University of Michigan. He will act as a point of contact between the university and the manufacturers of Michigan in the use of the facilities for research work at the university.

A. M. HALL, superintendent of the Wellman, Seaver Morgan Co. foundry for 16 years, and who has just returned from Newport News, has been elected president of the organization. Oscar Hackenburg has been made vice-president, J. C. Donald is secretary and J. C. Bins is treasurer. The foundry will specialize in gray castings up to five tons in weight.

JEAN BOYAU has been appointed resident engineer of Compagnie Francaise Thomson-Houston with headquarters at the offices of the International General Electric Co., Schenectady. He succeeds Jean Canivet, who was accidentally drowned on July 10. Mr. Boyau studied at the Lycée Carnot in Paris. He was awarded the Croix de Guerre and made Chevalier de la Légion d'Honneur for services in the World War.

Pamphlets Received

Methods of Handling Salesmen's Expenses. Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. Management Methods No. 5. Published by the Policy-holder's Service Bureau of the Metropolitan Life Insurance Co. This pamphlet is a report drawn from the successful experiences of representative companies. It endeavors to define legitimate expenses, explain the methods employed to control and reduce traveling expenses, and to verify the various items. A section of the report is devoted to the expenses incurred in the operation of automobiles. Charts are included in which the forms used by several companies are reproduced. The pamphlet will be found interesting, and includes valuable material for those dealing with salesmen's expenses.

Trade Catalogs

Diesel Engines. Fairbanks, Morse & Co., Chicago, Ill. Bulletin No. 1020, 8½x11 in., is a 24-page discussion of Diesel engine principles. There is a short historical sketch of the development of the Diesel engine, and drawings are used to explain the different types and their operation. The bulletin explains the operation of the 2-stage Fairbanks-Morse engine with its airless injection of fuel, and explains its feed control and regulation. The printing and the detailed illustrations in this catalog are excellent.

Electric Carburizing Furnaces. Automatic & Electric Furnaces, Ltd., Elecfurn Works, 173-175 Farringdon Road, London, E.C.I. This company has published Section C of its Catalog No. 925 on the Wild-Barfield electric furnaces for the case-hardening of steel. There are eight 8½x11-in. pages devoted to an explanation of the temperature control, the time switches and the cost of operation and upkeep of the Wild-Barfield furnaces.

Electric Motors. American Electric Motors, Inc., Milwaukee, Wis. Bulletin No. 122 has been published by this company as a part of its series of bulletins on polyphase induction motors, polishers and grinders and installation of their motors. The subject of this bulletin is the ball bearing, inclosed, self-ventilated polyphase induction motor built in sizes of from ½ to 100 horsepower.

Electric Motors. The Brown-Brockmeyer Co., Inc., Dayton, Ohio. Bulletin 7-7½ is devoted to this company's ½- and ¾-hp., alternating current, single-phase, induction motor. The details of construction of the "B-line" motor are given in detail, as well as its specifications and prices.

Heating Systems. The American Blower Co., Detroit, Mich., has published a circular describing the principles of operation of the American Blower direct-fired heaters. Illustrations and specifications are given of the models constructed.

Lift Trucks. "Multiplying Men" is the title of a folder published by the Stuebing Truck Co., 312-316 East Court St., Cincinnati, Ohio, covering the Model K Stuebing lift truck. Six features of construction are listed and illustrated.

Saws, Table. The Silver Manufacturing Co., Salem, Ohio, has published circulars to describe the No. 80 silver rolled top saw table and the No. 895 silver portable electric saw for rip sawing, mitering and crosscutting. Specifications of the machines are given, as well as an explanation of the uses to which the saws can be put.

Speed Reducers. William Ganschow Co., 1001 West Washington Blvd., Chicago, Ill. Catalog No. 111, 7½x10½ in., with a 62-page discussion of the various types in the line of Ganschow speed transformers. A full description, with many illustrations, is given of the planetary construction transformers. The line includes vertical, as well as horizontal, reducers, worm gear and compound type reducers. Tables are included to show the specifications of all models of this company. Many illustrations of actual installations are given in the catalog.

Steels. Anchor Drawn Steel Co., Latrobe, Pa. A bulletin has been prepared by this company to show the sizes and prices of its various grades of steel.

Tapping Attachments. Eastern Tube & Tool Co., Inc., 595 Johnson Ave., Brooklyn, N. Y. A circular gives specifications and details of the "Ettco" high-speed tapping attachment. A price list of parts is included.

Calendar of Local Meetings

National Association of Cost Accountants

Worcester Chapter. Dec. 10. "The Treatment of Slow Moving Products in Inventory."

Los Angeles Chapter. Dec. 15. "Cost of Producing and Transmission of Power." (with pictures.)

Cleveland Chapter. Dec. 16. "Budgetry Control and the Principles of Burden Distribution."

Rochester Chapter. Dec. 16. The methods employed in Rochester industries in the collection and distribution of manufacturing burden. Speakers, I. W. Briggs and Z. L. Augustine.

Buffalo Chapter. Dec. 17. "Handling Production Costs from Raw Material to Finished Product."

Boston Chapter. Dec. 17. "Administrative and Selling Costs," by Charles F. Rittenhouse.

Scranton Chapter. Dec. 22. "Inventory Control," by LeRoy Chappell.

San Francisco Chapter. Dec. 28. "Preparing to Start the New Year Right—What Should Be Done?"

Society of Automotive Engineers

Indianapolis. Dec. 10. Indiana Section meeting. Subject: "High Duty Engines."

Buffalo. Dec. 15. "Transportation Service," by Ernest Murphy.

Cleveland. Dec. 14.

Dayton. Dec. 16. "The Organization and Operation of the General Motors Proving Ground," by O. T. Kreusser.

Detroit. Dec. 17. Methods of Cylinder Lapping.

Chicago. Dec. 18. "Present Day High Efficiency Motors," by Fred S. Duesenberg.

Northern California. Dec. 29. "Problems of Fleet Operation," by Harold Jarvis.

New York. Jan. 14. Annual dinner, Hotel Astor.

Detroit. Jan. 26 to 29. Annual meeting.

American Society for Steel Treating

Buffalo. Jan. 21 and 22. Winter sectional meeting, Hotel Statler.

Hartford. June. Spring sectional meeting.

Forthcoming Meetings

American Association for the Advancement of Science. Annual meeting, Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Burton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

American Society for Steel Treating. Winter sectional meeting, Hotel Statler, Buffalo, N. Y., Jan. 21 and 22. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual meeting, General Motors Bldg., Detroit, Jan. 26 to 29. Coker F. Clarkson, secretary and general manager, 29 West 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Drop of 50c. to $1 per ton in coke prices during week has not affected firmness of pig-iron. Steel market is tending upward with advances in plates and sheets. Buying is also active in bars and semi-finished material. In the principal hot-rolled products, bars are $2@$2.10 per 100 lb., Pittsburgh, with the higher quotation gaining strength; shapes sell at $1.90@$2.10; plates, at $1.60@$2 per 100 lb., f.o.b. mill.

Non-Ferrous Materials—Tin is ⅝c. and antimony, ⅛c. per lb. above the Nov. 27 level at New York warehouses. Copper dropped ⅝c.; lead, ⅝c.; and zinc, ⅛c. per lb. during week.

(All prices as of Dec. 4)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00@23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.15	3.50
No. 12	2.45@2.55	3.94	3.20	3.55
No. 14	2.50@2.60	3.99	3.25	3.60
No. 16	2.60@2.70	4.09	3.35	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.15	3.75	3.90
Nos. 22 to 24	3.10@3.20	4.20	3.80	3.95
Nos. 26 and 27	3.15@3.25	4.25	3.85	4.00
No. 28	3.25@3.35	4.35	3.95	4.10
Galvanized				
No. 10	.3.50@3.60	4.35	4.25	4.25
Nos. 12 to 14	.3.60@3.70	4.45	4.35	4.35
No. 16	.3.75@3.85	4.60	4.50	4.50
Nos. 18 to 20	.3.90@4.00	4.75	4.65	4.65
Nos. 22 to 24	.4.05@4.15	4.90	4.70	4.80
Nos. 26 and 27	.4.20@4.30	5.05	4.95	4.95
No. 28	.4.50@4.60	5.35	5.10	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches — External	Diameters Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.15	50%	⅞	$0.18	35%
⅜	.16	45%	1	.19	31%
½	.17	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.30 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	....	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	....	6.20
Hoop steel	4.49	....	4.15
Cold rolled strip steel	6.35	....	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.90	3.60
Cold drawn flats, squares	4.65	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	60%

Electric welding wire, New York, ⅛, 8.25c.; ¼, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 1/16@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.50
Tin, 5-ton lots, New York			64.62½
Lead (up to carlots) E. St. Louis	9.35	New York	10.25
Zinc (up to carlots) E. St. Louis	8.60	New York	9.75

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	21.50	20.50	20.00
Copper sheets, base	23.25	23.25	23.00
Copper wire, base	20.37½	17.12½	17@17½
Copper bars, base	22.37½	21.75	22@22½
Copper tubing, base	25.25	25.25	25.00
Brass sheets, base	19.62½	19.62½	19.37½
Brass tubing, base	24.25	24.25	.....
Brass rods, base	17.37½	17.37½	17.12½
Brass wire, base	20.12½	20.12½	20.50

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	28@29	28.00	28.03
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.25	41.00	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			80.37½
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			15.00
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00	Electrolytic 38.00	Shot	32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.00@12.25	12.00	11.75@12.25
Copper, heavy, and wire	11.75@12.00	11.37½	11.25@11.75
Copper, light, and bottoms	9.50@10.00	9.75	10.25@10.75
Heavy lead	8.37½@8.87½	8.00	8.50@8.75
Tea lead	6.00@7.00	7.50	7.50@7.75
Brass, heavy, yellow	7.25@7.50	7.50	7.25@7.75
Brass, heavy, red	9.50@10.00	9.75	9.25@9.50
Brass, light	6.00@6.50	....	7.25@7.75
No. 1 yellow rod turnings	8.25@8.50	8.25	7.50@7.75
Zinc	5.25@5.75	4.75	5.00@5.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.30	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.18	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	.99	1.13	.99
Lard cutting oil, 25% lard, per gal.	.55	.50	.54
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	40–5%
Heavy grade	30–10%	35%	30–10–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.0415	.0415	.0405
Brass rods	per lb	.1737½	.1687½	.1637½
Solder (½ and ½)	per lb.	.4025	.40	.40@.41
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.49
Cloth	3.55	2.67	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@4.00
Coke, prompt foundry, Connellsville	per net ton		4.50@5.00
White lead, dry or in oil	100 lb. kegs	New York, 15 25	
Red lead, dry	100 lb. kegs	New York, 15 25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1½x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{1}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{3}{16}$-in and smaller and 65% for ¼-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x 2$\frac{1}{16}$-in. to 4$\frac{1}{16}$-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅞-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Mass., Charlemont — Frary Mfg. Co. — Waymouth & Frary automatic lathes and tool maker for wood turning factory.

Mass., Charlestown (Boston P. O.)—J. L. Duncan, 8 Sherman St.—5 in. radial drill, No. 7 beaudry hammer.

Mass., Wakefield—Morrison Skinner Co. punch press, Bliss No. 19 or equal, small back geared press.

Mass., Winthrop (Boston P. O.)—Henry E. Keough Co., 28 Pauline St.—geared pipe cutter 2½ to 61 in. Toledo No. 250 or similar to be used with power drive.

Mich., Detroit—Dept. of Street Railways, St. Jean and Shoemaker Aves., F. Meyer, Jr., Purch. Agt.—wheel grinder.

Mich., Detroit—Federal Tool & Die Co., 6343 Wight St. (dies and tools)—die making machines.

Mo., St. Louis—St. Louis Trunk Hardware Mfg. Co., 609 Chouteau Ave.—equipment for proposed 1 story, 100 x 400 ft. plant, probably presses, metal working and plating machinery. Estimated cost $225,000.

N. Y., Brooklyn — Fulton Tool Co., 702 Kent Ave.—V. & O. No. 2 power press.

N. Y., Jamaica — G. Jameson, 4 Park View Ave.—shaper and cutter.

Pa., Crafton—J. M. Parsons, 91 Fountain Ave.—sheet metal break up to ⅛ in. 8 to 10 ft. long.

Pa., Uniontown—Richmond Radiator Co. 4 enameling ovens and 4 molding machines.

Va., Pulaski — Pulaski Foundry & Mfg. Corp.— core oven, air compressor.

Wis., Milwaukee — R. W. Z. Specialty Corp., 1310 Burnham St. (auto parts and sheet metal products)—sheet metal machinery, drill press, grinders.

Wis., Waukesha — Manitowoc Church Furniture Co., 1214 Lincoln Ave.—special machinery for carving and engraving wood.

Wis., Waukesha—Waukesha Motor Co., West St. Paul Ave.—additional machine tools for proposed 1 story, 64 x 154 ft. machine shop. Estimated cost $30,000.

Wis., West Allis—Janka Millwork Mfg. Co., 680 54th Ave.—woodworking machinery and motors for proposed 2 story factory on Beloit Road. Estimated cost $40,000.

Ont., Collingwood — Huronia Steel Co., J. A. Currie, Mgr. — equipment for the manufacture of auto locomotive castings and stainless steel. Owner has taken over electric castings plant. Estimated cost $100,000.

Ont., Kingsville—G. Hall—prices on complete equipment for garage and auto repair shop. Estimated cost $50,000.

Que., Belanger Siding—A. J. Morin—jig saw, planer, etc.

Que., Montreal—Garage Marcotte, 1861 Bordeaut St., A. Marcotte, Purch. Agt. (auto repairs, etc.)—small lathe and tools.

Que., Nominingue—E. Godard (sawmill) cutoff, rip and band saws.

Que., O'Brien — Rouyn Construction Co., Ltd., J. W. Forde, Solicitor—complete sawmill equipment.

Que., St. Marcel — A. Fortin — sawmill equipment.

Australia, Melbourne—Victorian Government Railways, will receive bids until Jan. 27, 1926, for one vertical boring and turning mill with equipment.

Opportunities for Future Business

Calif., Los Angeles—Santee Garage Co., c/o Pinner Construction Co., Lankershim Bldg., contractor, awarded contract for the construction of a 6 story garage. $350,000.

Colo., Denver—The Denver & Rio Grande Western Co., Equitable Bldg., plans improvements to machine shops and machinery. Estimated cost $63,000 included in 1926 budget. O. A. Ridgway, Ch. Engr.

Conn., Hartford — The Evarts Machine Co., 17 Francis St., awarded contract for the construction of a 1 story, 36 x 55 ft. addition to factory.

Conn., Hartford—One Hundred Eighteenth Connecticut National Guard, awarded contract for the construction of a 1 story armory including machine shop, etc. at Brainard Field. Estimated cost $60,000. Noted Nov. 5.

Conn., Southington—Peck, Stow & Wilcox awarded contract for the construction of a 2 story addition to hardware factory.

Fla., West Palm Beach—H. P. Bryan, c/o B. Kitchell, Archt., plans the construction of an 8 story, 140 x 150 ft. garage. Estimated cost $500,000.

Ill., Chicago — Dole Valve Co., 1923 Carroll Ave., awarded contract for the construction of a 3 story, 120 x 123 ft. factory and storage building. Estimated cost $60,000.

Ind., Hammond—Standard Steel Car Co. awarded contract for the construction of a 1 story, 80 x 335 ft. car factory. Estimated cost $200,000.

Ind., Indianapolis—George M. Diehl Machine Works has work under way on the construction of a 2 story addition to plant. Two additions to be built later.

Ind., Rushville—Dill Foundry Co. plans the construction of a 1 story, 140 x 180 ft. foundry. Estimated cost $50,000. Private plans.

Md., Baltimore—W. S. Austin, Maryland Trust Bldg., Engr. will receive bids until Dec. 14 for the construction of a 1 story, 100 x 260 ft. foundry at Garrett Ave. and Taylor St. for The Flynn & Emrich Co., 305 North Holliday St. Estimated cost $50,000.

Mass., Atlantic (Boston P. O.)—Norfolk Woodworking Co., Braintree, plans the construction of a 1 story, 140 x 260 ft. mill here. Estimated cost $225,000. L. S. Joslin, 339 Newbury St., Boston, Archt. Owner will build by separate contracts. Noted Oct. 22.

Mass., Boston—Park Square Garage, Inc., c/o National Engineering Corp., 60 Federal St., Engrs., is having preliminary plans prepared for the construction of a garage at St. James Ave. and Stuart St. Estimated cost to exceed $150,000.

Mass., Brookline (Boston P. O.)—Meltzer & Snider, Strathmore Road, is receiving bids for the construction of a 1 story, 135 x 175 ft. repair and service garage. Estimated cost $100,000. S. S. Eisenberg, 46 Cornhill, Boston, Archt.

Mass., Fall River—Fall River Gas Works Co., 393 Madison Ave., awarded contract for the construction of a 1 story, 55 x 119 ft. garage and repair shop. Estimated cost $40,000. Noted Nov. 5.

Mass., Fall River—Webb Oil Co., 8 Durfee St., awarded contract for the construction of a 2 story, 105 x 140 ft. repair and service garage. Estimated cost $70,000. Noted Oct. 8.

Mass., Hyde Park (Boston P. O.)—Bay State Furniture Co., Business St., is having plans prepared for the construction of a 1 and 2 story addition to factory. Estimated cost $40,000. Private plans.

Mass., Roxbury (Boston P. O.) — I. Cabitt, 6 Castlegate Road, awarded contract for the construction of a 1 story repair and service garage. Estimated cost $50,000.

Mass., Roxbury (Boston P. O.) — Exchange Realty Co., 829 Old South Bldg., Boston, awarded contract for the construction of a 1 story, 90 x 262 ft. repair and service garage at Washington and Westminster Sts., here. Estimated cost $125,000.

Mass., Watertown (Boston P. O.)—American Soda Fountain Co., 282 Congress St., Boston, will soon receive bids for the construction of a 1 and 2 story, 175 x 380 ft. manufacturing plant and storage building, here. Estimated cost $40,000. Monks & Johnson, 99 Chauncy St., Boston, Archts. Noted Sept. 24.

Mass., West Springfield (Springfield P. O.)—New England Smelting Co., 220 Union St., has work under way on the construction of addition to plant. Estimated cost $40,000. Noted Nov. 12.

Mich., Menominee—Menominee Lumber & Cedar Co., North State St., will build a 2 story, 62 x 85 ft. lathe and shingle mill. Estimated cost $40,000. Private plans. Noted Nov. 5.

Mo., St. Louis—Reid Bros. Express Co., 6111 Bertha Ave., awarded contract for the construction of a 2 story garage at 890-912 Hodiamont Ave. Estimated cost $150,000.

N. J., Camden — Acme Staple Co., 1643 Haddon Ave., awarded contract for the construction of a 2 story, 87 x 145 ft. addition to factory. Estimated cost $55,000. Noted Oct. 29.

O., Cleveland — The Six Thousand One Hundred Fifteen Carnegie Co. c/o I. O. Weissblatt, Secy. and Treas. c/o Carnegie Body & Auto Top Co., is having preliminary plans prepared for the construction of a 3 story factory. Estimated cost $175,000. N. Petti, Williamson Bldg., Archt.

O., Columbus—Civic Improvement Assn., R. L. Wirtz, 99 North Front St., will build a 2 story, 62½ x 187½ ft. garage at Front and Elm Sts. Estimated cost $65,000. J. E. Outcalt, 205 East Broad St., Archt.

Pa., Philadelphia — J. J. Greenberg, Widener Bldg., plans the construction of a 78 x 235 x 295 ft. auto sales and service building at Broad Ridge Ave. Melon and Patts Sts. P. S. Tyre, 114 South 15th St., Archt.

Pa., Pittsburgh — Eric Fisher Wood & Co., Oliver Ave. and Smithfield St., Archts. are receiving bids for the construction of a 2 story, 106 x 150 ft. sales and service building for F. D. Saupp, Inc., Center Ave. Estimated cost $150,000. Noted Sept. 3.

Pa., Swissvale (Pittsburgh P. O.)—Union Switch & Signal Co. awarded contract for the construction of a 1 story, 22 x 122 ft. forge and machine shop. Estimated cost $40,000.

Pa., Uniontown — Truscon Steel Co., Oliver Bldg., Pittsburgh, Engr. will build a 1 story addition to radiator plant including a foundry, warehouse, machine department, testing and enamel departments for Richmond Radiator Co. Estimated cost $46,000.

Wis., Milwaukee — Packard Motor Car Co., 35th St. and Grand Ave., will revise plans and take new bids for the construction of a 1 story, 72 x 200 ft. addition to garage. Estimated cost $150,000. Brust & Philipp, 405 Broadway, Archts. Former bids rejected.

Wis., Milwaukee—The Prescott Co., manufacturers of oil line pumps, saw mill machinery, mine pumps, etc., plans the construction of a 3 sotry addition to pattern shop and an 80 ft. extension to foundry in connection with main machine shop.

Que., Cap de la Madeline—Canadian International Paper Co., R. F. Grant, Local Mgr., Three Rivers, has work under way on the construction of a 1 story, 100 x 150 ft. saw mill, here. Estimated cost $160,000. A. H. White, New York, Engr.